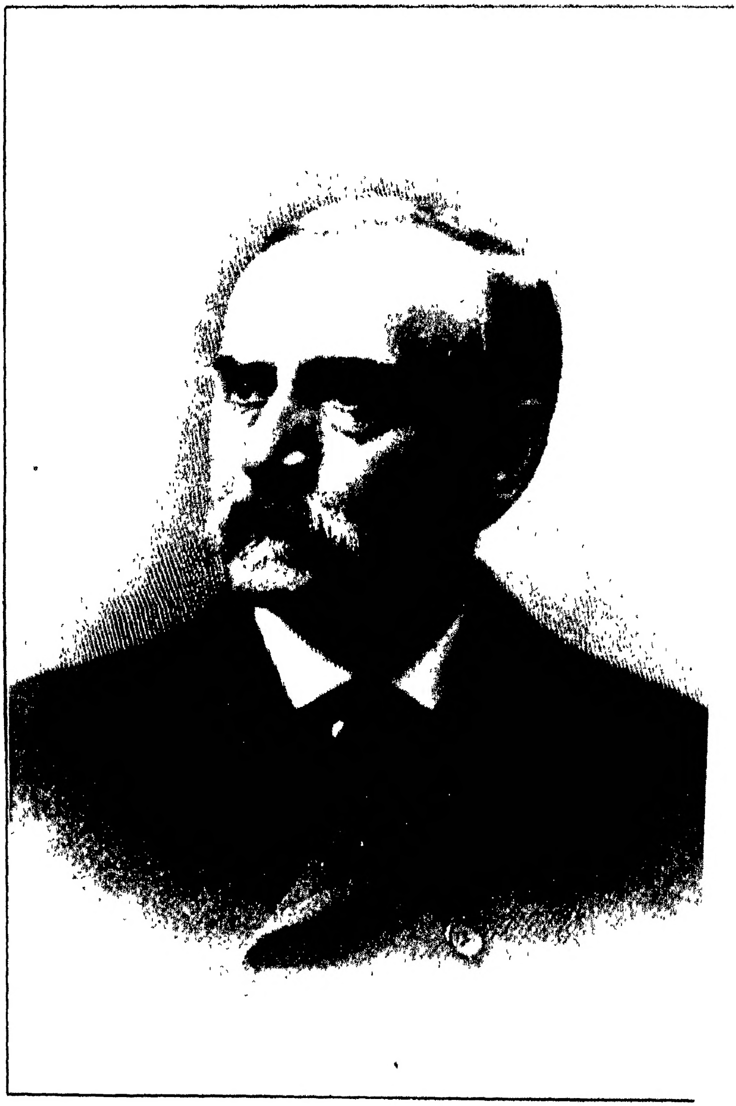

J. STERLING MORTON.

SECRETARY OF AGRICULTURE, 1893 TO 1897.

[BORN APRIL 22, 1832; DIED APRIL 27, 1902.]

YEARBOOK

OF THE

UNITED STATES

DEPARTMENT OF AGRICULTURE.

1901.

WASHINGTON:
2 GOVERNMENT PRINTING OFFICE.
1902.

[CHAPTER 23, Stat. at L., 1895.]

[AN ACT providing for the public printing and binding and the distribution of public documents.]

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Section 73, paragraph 2:

The Annual Report of the Secretary of Agriculture shall hereafter be submitted and printed in two parts, as follows: Part One, which shall contain purely business and executive matter which it is necessary for the Secretary to submit to the President and Congress; Part Two, which shall contain such reports from the different Bureaus and Divisions, and such papers prepared by their special agents, accompanied by suitable illustrations, as shall, in the opinion of the Secretary, be specially suited to interest and instruct the farmers of the country, and to include a general report of the operations of the Department for their information. There shall be printed of Part One, one thousand copies for the Senate, two thousand copies for the House, and three thousand copies for the Department of Agriculture; and of Part Two, one hundred and ten thousand copies for the use of the Senate, three hundred and sixty thousand copies for the use of the House of Representatives, and thirty thousand copies for the use of the Department of Agriculture, the illustrations for the same to be executed under the supervision of the Public Printer, in accordance with directions of the Joint Committee on Printing, said illustrations to be subject to the approval of the Secretary of Agriculture; and the title of each of the said parts shall be such as to show that such part is complete in itself.

PREFACE.

The Yearbook of the Department of Agriculture for 1901 contains no unusual features calling for special mention. It was recognized last year that the Yearbook has assumed a somewhat inconvenient size, yet, notwithstanding this recognition, the volume for 1900 was the largest of the series, containing 888 pages. The desirability of reducing this bulkiness has not been overlooked this year, and, although the present volume will contain, besides the Appendix and the Report of the Secretary, thirty-three articles, as against thirty-one last year, the number of pages will be slightly less. In the number of miscellaneous articles and plate illustrations, however, it exceeds most of its predecessors. As usual, the Annual Report of the Secretary, with which the book opens, gives the general review of the operations of the Department for the year, as is required in order to comply with the law. Including this report and the thirty-three miscellaneous articles, there are 608 pages of printed matter, the remainder of the volume consisting of the Appendix and the Index. The illustrations include 91 plates (18 of them colored) and 52 text figures.

In accordance with the clearly understood views of the Secretary, the original articles contributed to the Yearbook are mainly general in character and of general application, though some treat of subjects which have been of special benefit to particular sections, and all are thoroughly representative of the varied scientific work conducted by the Department. Thirty-one of the articles are contributed by persons actually engaged in the Department work; of the other two, one is contributed by an investigator indirectly connected with the Department as an officer of a State experiment station, and the second, by a gentleman who for many years was a member of the forestry force of the Department, and who is at present engaged in the same line of investigations in another Department of the Government.

The work of the Department during recent years has assumed such varied proportions and covers so many independent lines of inquiry as to make it well-nigh impossible to comprise, within the limits of a single Yearbook, articles representing each of these lines of inquiry. Taken as a whole, however, the contributions to the present volume very fairly represent the wide scope of the work carried on in the Department.

The recent death of Hon. J. Sterling Morton, Secretary of Agriculture from March 7, 1893, to March 5, 1897, makes eminently appropriate the use of his picture as a frontispiece to this volume, and it has been so used by order of the present Secretary.

The effort to make the Appendix a most useful, if not an indispensable work of reference for the farmer, which will of itself make the Yearbook a valuable addition to every farm library, has been maintained this year. Want of space makes it impossible to increase the number of pages devoted to this part of the work, and consequently the enlargement of its scope and additions to the information it contains necessitate a constant epitomizing. The Appendix of the present volume has been carefully revised and several interesting features have been added. The directory of officials interested in agriculture as the representatives of National and State governments and associations is more complete, and includes a number of new addresses.

The reviews of weather conditions, insect ravages, plant diseases, forest and forage conditions, fruit growing, irrigation, and road building have been prepared in the several Divisions of the Department having charge of those features. Where this work has been done by one person the name is now given as in the other articles of the Yearbook; for the matter is wholly original and is believed to represent as much effort and care as any other part of the book.

The statistical tables in the Appendix follow the rearrangement adopted last year, so that all statistical information upon any given crop appears on consecutive pages. The change from the old form seems to have met with general approval.

So far as practicable the reports of the Twelfth Census upon special crops and agricultural industries have been presented in the form deemed to be best adapted to the requirements of the Yearbook and easy use by its readers. Among the tables so adapted are those on tobacco, bees and honey, and poultry and eggs. The figures for crops heretofore regularly reported by the Division of Statistics have been subject to some modification, in accordance with new information secured by the Twelfth Census, but a complete readjustment has not been possible, owing to the necessary revision by the Census Bureau of its own figures. The main reliance in compiling the statistics for these more important crops and for farm animals has been the reports of the correspondents of this Department, and conservative action is advisable in revising these reports to agree with figures from the house-to-house canvass of the Census; for the student's comparison of statistics as presented from year to year in the Yearbook must involve, for most years, figures furnished by these correspondents, and not Census figures.

Attention is called to the table on time of planting for important crops and the table on the weight of the bushel, in the hope that corrections may be secured in the first case and uniformity promoted in the second.

GEO. WM. HILL,
Editor Yearbook.

WASHINGTON, D. C., *May 9, 1902.*

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YEARBOOK

OF THE

U. S. DEPARTMENT OF AGRICULTURE.

REPORT OF THE SECRETARY.

To the President:

The Department of Agriculture has reached farther into sympathy with the industries of the people during the past year. It has identified itself more intimately with the experiment stations of the several States and Territories and what pertains to the interests of their people. It has gone farther in foreign lands to find many things that will be valuable to our producers. The grouping of related sciences into Bureaus has economized time and contributed to efficiency. The process could be advantageously extended to other Divisions and Offices that are growing beyond their present environment.

The education of student assistants and scientific aids in their several specialties goes on satisfactorily under the scientists in charge, giving promise of high efficiency in the future personnel of the Department.

NEW BUILDING NEEDED.

The growth of the Department causes continual overflow into rented buildings that now cost over $10,000 a year. This, and the danger of loss by fire of material that has been accumulating for years and could not be replaced, induced the Congress to appropriate $5,000 at its last session to provide for the selection of an architect and plans for a new building, which has been done with the cooperation of the Architect of the Treasury, under whose direction a commission was selected to pass upon the drawings, consisting of Messrs. D. H. Burnham, C. F. McKim, Augustus Saint Gaudens, F. L. Olmsted, jr., and James Knox Taylor, and a report upon the action taken will be submitted to the two Houses of Congress at an early date.

OUR DUTY TO NEW POSSESSIONS.

The extension of American jurisdiction over islands in the Tropics brings new problems to the student of agricultural science. We buy annually over $400,000,000 worth of the products of foreign fields,

one-half of which will, at no distant period of time, be grown in the United States; the other half is the product of such climates as prevail in our new island possessions. It is the privilege and duty of the Department of Agriculture to teach the people of those islands to produce what we now buy from tropical countries, that they may have incomes to help toward their growth in all desirable directions.

The topics discussed in the reports of the Bureaus, Divisions, and Offices of the Department are indicated in the following brief paragraphs:

SUMMARY.

THE WEATHER.—The Weather Bureau has established cooperation with Europe in the interchange of weather forecasts. The farmer in the country is receiving his weather forecasts with his mail through rural-free delivery. Progress is being made in perfecting wireless telegraphy.

ANIMAL INDUSTRY.—Our animals are the healthiest in the world, and the people at home and abroad are protected by the inspection of meats in 51 cities and 156 abattoirs. Exports of animals and animal products amount to $253,000,000. Imported animals are inspected. Animal diseases are being eradicated by serums and vaccines sent out from the Department. State restriction of interstate traffic in live stock is in the courts.

PLANT INDUSTRY.—The diseases of cotton and other plants are being investigated. Plant breeding to obtain forms that will resist disease and be better adapted to new and changed conditions is being successfully carried on. A new method of cultivating and distributing the seeds of bacteria that cooperate with leguminous plants in developing nitrogen has been discovered. Antidotes for many poisonous plants have been found. Improved methods of curing grass seeds have been put in operation. Experiments with clover seeds show the superiority of the American over the foreign kinds. Tropical agriculture is being studied and the people of our island possessions are being taught better methods of growing coffee and other plants. The improvement of grasses on the Western ranges is being studied. Cooperation is had with most of the experiment stations about the country. Markets for our fruits are being successfully opened in foreign countries. The hop, prune, and other industries of the Pacific coast are being helped by the Department's investigations and importations. The Arlington farm is being brought into condition for use. Satisfactory results are being obtained from tea cultivation. Macaroni wheats are being successfully grown in our semiarid localities. Superior barleys for commercial purposes have been introduced. Egyptian cottons are being successfully grown, and the importation of the date palm has been a success. The Congressional seed distribution has been reorganized.

SOILS.—The Bureau of Soils is a necessity to find suitable soils for the new plants introduced, as well as the soils most suitable for our staple crops. Sumatra tobacco is being successfully grown in the Connecticut Valley and in Florida. Experimentation is being conducted in Pennsylvania in the growing of Havana filler tobacco, and this will be extended to Ohio, Texas, and the island possessions. The growers of the several fruits, table vegetables, and sugar beets, both

East and West, are being helped by the finding and mapping of suitable soils. Soil surveys are of benefit to Western irrigated districts. State organizations are cooperating in soil investigations, and these will be extended to the island possessions to help them in producing what can not be grown in the United States. Extensive areas of alkali lands in the mountain States are being reclaimed in cooperation with the Bureau of Soils. New processes of tobacco fermentation avoid losses by black rot.

CHEMISTRY.—The composition, nutritive value, and adulteration of food products are inquired into, and extensive work is done in the study of food preservatives. Much work has been done in the investigation of the adulterations of imported food products, and the results will soon be given to the public. The chemistry of woods is studied in cooperation with the Bureau of Forestry. A special study is made of the problems relating to sugar-producing plants. The physical and chemical study of road materials is now established in the laboratory. Work is done in the laboratory of this Bureau for all Departments of the Government.

FORESTRY.—The study of forests, forest fires, forest grazing, commercial trees, lumbering, and forest products for the Federal and State governments and for private individuals is included in the work of this Bureau. Tree planting for wood lots, shelter belts, and commercial plantations is a prominent feature. Assistance is given to the Interior Department in the study of the scientific work of the forest reserves. This Bureau is getting into close touch with all the forest interests of the country. Over 52,000,000 acres of forest lands throughout the United States are under its consideration. Commercial lumber companies in all parts of the country are asking help in the management of their properties. An Appalachian forest reserve, to protect the headwaters of important Southern streams, is recommended. Investigations to improve the methods of turpentine orcharding are being conducted.

EXPERIMENT STATIONS.—Inquiry shows that the experiment stations of the several States are working in the interest of their respective localities. Satisfactory progress is being made and the States are more liberal in helping the stations. The Department of Agriculture is cooperating extensively with the stations. Satisfactory reports come from the work in Alaska, which the people there are appreciating. Progress is being made in the establishment of experiment stations in Hawaii and Porto Rico, and there is much need of a beginning in the Philippines. Improvement is suggested in agricultural education. The farmers' institute work might be assisted. Interest grows in the study of the nutrition of man. Economy in the feeding of the human family would promote health and save money.

Irrigation.—The irrigation laws of the States have been studied and investigations made of the methods by which water is conserved, distributed, and used. The titles to water should be better understood and the disposal of water should be safeguarded. The Department's investigation is suggesting the enactment by the States of new and more intelligent legislation. The people interested should sanction all innovations, and they should be helped to do what localities can not do. Extensive irrigation works, such as the damming of large rivers, should be built by the Federal Government.

ENTOMOLOGY.—This Division has completed its work with the fig-fertilizing insect and has written up its history. Probably 75 tons of figs fertilized in this way will be put on the market this year. The original home of the San Jose scale has been found, after long investigation in the Orient, to be in northern China. The beetle that preys upon it is being brought in considerable numbers to the United States for distribution to orchards. The scale was found near the Great Wall, where no foreign nursery stock of any kind had ever been introduced. Its natural enemy keeps it in such check there that the native fruits grow successfully. After eight years of effort success has been reached in the introduction into the United States of a caterpillar from Italy that preys upon the black scale, a serious enemy to olive and citrus trees in California. This scale is a native of the region from which the caterpillar has been introduced, and along the shores of the Mediterranean the latter keeps the scale in subjection. A beetle has been introduced from Hungary that is a natural enemy to several destructive plant lice which have been accidentally imported into this country from Europe. A fungous disease of grasshoppers has been imported from South Africa and experimentally used in different parts of the United States through the summer of 1900–1901. In some localities it appears to have taken hold successfully.

Other work of this Division may be summarized as follows: During the past year the insects affecting the violet, the rose, and other ornamental plants have been studied. Work has been done in cooperation with the Bureau of Soils looking to the eradication of mosquitoes. A study of flies has indicated the importance of these creatures in the carriage of internal diseases. Systematic work is being projected to deal with the cotton-boll weevil of Texas.

PUBLIC ROADS.—This Office studies the condition of the roads, publishes information with regard to their improvement, the obstacles in the way, and the best means of securing better highways. Object-lesson roads have been built in nine States during the past year. The laboratory for testing the chemical and physical properties of road materials, conducted under the direction of the Bureau of Chemistry, has been in successful operation during the year. An agent of the Department is located in each of four geographic subdivisions of the United States to study and report upon local conditions.

PUBLICATIONS.—The work of this Division affords a fair reflex of the activity of the Department. During the year 1901 there were issued 606 publications, aggregating nearly 8,000,000 copies. Of these, 3,345,000 were Farmers' Bulletins. The Yearbook of the Department continues to be in great demand. Many of the Department's agents throughout the country receive no compensation except copies of our publications. A larger number of the Yearbook should be assigned to the Department. The publications of this Department are in demand among the people. The agent who sells governmental documents shows that during 1901, 24,127 copies of publications from this Department were sold, as against 9,458 from all other Departments. Congress at its last session greatly increased the number of Farmers' Bulletins to be printed and furnished to Members. A sufficient amount of money for their publication and distribution was not appropriated.

FOREIGN MARKETS.—Agriculture contributed conspicuously to the expansion of American commerce during the past year. The highest

record attained in the exportation of agricultural products previous to last year was surpassed by more than $90,000,000 for the fiscal year 1901, when a value of over $950,000,000 was reached. Fully 65 per cent of domestic merchandise sent abroad during that year originated on the farm. The most important foreign markets for our surplus products are in the United Kingdom, Germany, France, the Netherlands, and Belgium. We sent to Cuba, Porto Rico, and the Philippine Islands in 1901, $18,600,000 worth of exports, being about 53 per cent of their receipts in those islands. They are increasing in Porto Rico and the Philippines and declining in Cuba. Our imports from these three island groups increased from $36,162,000 in 1900 to $48,600,000 in 1901, the bulk of the gain being in the imports from Cuba. Of the $70,000,000 worth of domestic merchandise exported from the Pacific coast during the fiscal year 1900, $45,000,000 worth consisted of farm produce.

Library.—We have the most extensive agricultural library in the country. Four thousand books and pamphlets were added during the past year. Reference lists with regard to publications on land drainage, tobacco, etc., have been prepared. The constantly broadening field of investigation makes increased demands upon the Library, and it is necessary that our scientists have access to the work done at home and abroad. The agricultural colleges and experiment stations are drawing upon the resources of the Library to assist them in special work. An increased appropriation to permit of the engagement of scientific aids in library work is much needed. The Library room, like the other quarters of the Department, is entirely inadequate.

Accounts and Disbursements.—Congress appropriated $3,303,500 for the Department for the fiscal year ended June 30, 1901. Final payments will amount to about $3,200,000. Owing to inadequate accommodations in the Department proper, our rentals for outside buildings for the fiscal year 1902 will exceed $10,000.

Biological Survey.—This Division is engaged in mapping the boundaries of the natural crop belts of the country, and aims to furnish the American farmer with lists of crops likely to succeed in different parts of the country. The work has been done in Texas and California to a great extent during the past season. A fiber plant has been discovered that grows over 20,000 square miles of land in Texas, and the Biologist thinks that the fiber of this plant may take the place of over $12,000,000 worth of the fiber of other species of agave annually imported, mostly from Mexico. The fog zones of California mostly run north and south, owing to the trend of the mountains, and interesting deductions for fruit growers are reached. The prairie dog of the great plains that stretch from Montana and the Dakotas into Texas is increasing rapidly, owing to the destruction of its natural enemies, to the serious injury of pasture grasses. Field experiments are being conducted looking to its destruction.

Observation of birds in southern California shows that two of them feed extensively on the olive scale. The large blackbirds of southern Texas that feed on crayfish which cut the rice plant and on the cabbage worm have been slaughtered in great numbers for the millinery trade. These studies in ornithology have a direct bearing upon crop production. Farmers' Bulletins on these topics are being distributed in large editions. This Division is charged with the supervision of

matters relating to game protection and introduction and executes the Lacey Act. It gives permits for the importation of birds and supervises their movement in interstate commerce. This service will be extended to Hawaii in the coming year. More liberal appropriations are required to carry on the valuable work of the Biological Survey.

Statistics.—The Division of Statistics has 250,000 reporters located throughout the United States, who furnish facts monthly regarding the crops. Its work consists in the preparation of reports relative to the principal products, the condition and prospects of the crop during the growing season, and the quantity, quality, and disposition of the product harvested. There is urgent necessity for extending this work to other products, such as live stock, fruits, sugar, rice, etc. Agents are already organized to collect the facts, and only the addition of a sufficient number of compilers to collate and analyze these facts is necessary to the extension of the work. Negotiations with foreign governments, looking to the telegraphic interchange of crop reports, have been undertaken. The statistician has had marked success in estimating the cotton and other crops during the last few years.

WEATHER BUREAU.

NEW OCEAN FORECASTS AND INTERNATIONAL COOPERATION.

An important extension of the forecast work of the Weather Bureau has been made during the year. By an arrangement with the secretary of the meteorological office at London, England, the transmission by cable from London to Washington of meteorological reports from certain points in the British Isles and on the Continent of Europe, and from Ponta Delgada, Azores, was begun December 18, 1900. These reports, with observations from Nassau, Bermuda, and Turks Island, have been regularly published on the daily weather maps issued at Washington, Baltimore, Philadelphia, New York, and Boston, together with forecasts of the force and direction of the wind and the state of the weather for the first three days out of steamers bound east from American ports.

The Atlantic forecasts, which are based on the American, Atlantic, and European telegraphic reports, were begun January 7, 1901, and on June 1, 1901, they were made a part of the regular general night forecasts issued at Washington. In a number of instances, when storms of marked strength were passing eastward off the American coast, forecasts were issued of the character of the weather which would probably be experienced by steamers leaving European ports westward bound, and by an arrangement with Lloyd's, of London, these advices have been cabled to England.

In addition to the daily forecasts of wind and weather and special storm warnings, predictions of fog have been issued when conditions favorable for fog development have been indicated in the steamer tracks west of the fiftieth meridian. Reports from trans-Atlantic

steamships show that these forecasts and special warnings have been well verified.

In November, 1900, arrangements were made with Portugal to receive reports from the meteorological observatory at Horta, in the Azores. Observations are now regularly received by cable from that place, and they are of much value in the work of forecasting the movements of storms on the Atlantic Ocean.

THE GALVESTON HURRICANE.

The principal storm of the year was the West Indian hurricane which devastated Galveston, Tex., September 8, 1900. This was one of the most destructive storms on record. Upward of 6,000 human lives were lost, and property to the estimated value of $30,000,000 was destroyed.

The wisdom of Congress in appropriating for the establishment of weather stations in the West Indies was well demonstrated by the warnings that were issued well in advance of this storm, from the time of its inception in the Caribbean Sea to its arrival at Galveston, and thence throughout its course to the Great Lakes and onward to the Atlantic Ocean.

NEW FORECAST DISTRICTS.

Three additional forecasting districts have been established and designated as the New England district, the West Gulf district, and the Rocky Mountain district, with headquarters at Boston, New Orleans, and Denver, respectively. The last appropriation bill passed by Congress made provision for three additional forecast officials to be placed in charge of these districts with authority to issue forecasts and warnings for the several States that are comprised in each district. This system has the advantage of enabling the forecaster to devote more time to the consideration of the predictions for each State and of securing an earlier distribution of forecasts. As these forecast officials were selected on account of their ability as forecasters for their respective sections, it is expected that an improved service will result.

IMPROVEMENT IN FORECASTS.

Special consideration has been given to the subject of increasing the accuracy of the forecasts of the Weather Bureau to the highest degree attainable, and as a means of stimulating among the employees of the Bureau the study of the problems of weather forecasting announcement has been made that hereafter marked success in forecasting, the invention of new methods of forecasting, or the discovery of new facts

or principles of marked value to the forecaster will have a special weight in considering the merits of employees of whatever grade for promotion.

RECENT EXTENSION OF WEATHER SERVICE.

It is a wonderful picture of atmospheric conditions that is now presented twice daily to the trained eye of the weather forecaster. In addition to the reports from Europe, the Azores, and Bermuda, the field embraces an area extending from the Atlantic to the Pacific, from the north coast of South America over Mexico, the islands of the West Indies and the Bahamas, northward to the uttermost confines of Canadian habitation. It is a panoramic picture of the exact air conditions over this broad area that is twice daily presented to the study of our experts. Hurricanes, cold waves, hot waves, or rain storms are shown wherever present in this broad area. Their development since last report is noted, and from the knowledge thus gained their future course and intensity is quite successfully forecast. Every twelve hours the kaleidoscope changes, and a new graphic picture of weather conditions is shown. Nowhere else in the world can meteorologists find such an opportunity to study storms and atmospheric changes.

CLIMATE AND CROP WORK.

The lines of work pursued in previous years by the climate and crop service of the Weather Bureau were continued and extensions and improvements made wherever possible. The cotton-region service has been extended into Oklahoma and the Indian Territory, and arrangements have been made for inaugurating a similar work in California, to be known as the fruit and wheat service.

FORECASTS TO FARMERS BY RURAL FREE DELIVERY.

Particular attention has been given to the distribution of forecasts by means of the rural free delivery. There are now in operation 365 centers, supplying an aggregate of nearly 42,000 families in the farming districts with the latest weather predictions. This work has become decidedly popular, and we have had the hearty cooperation of the Post-Office Department in making it a success. With some additional appropriation, it is the intention to reach several hundred thousand farmhouses with the daily forecasts and warnings during the coming year. The value of frost and cold-wave warnings to rural communities is beyond estimate, and the rural free delivery of the Post-Office Department places the means at our command of reaching those who can be the most benefited by these warnings.

WIRELESS TELEGRAPHY.

The vast extent of our sea and lake coasts and the intimate communication between the Weather Bureau stations of this Department, which are distributed along these coast lines, and the vessels of commerce have induced me to authorize persistent and systematic experimentation in etheric space telegraphy. Substantial improvements have been made during the past year in the Department's system.

The line of research has been divided into three classes: First, the perfection of a more powerful transmitter, in which the energy of radiation shall be greatly increased; second, the devising of a more delicate receiver—one that would be positive instead of depending upon an imperfect and variable contact, as do all systems now in use; and, third, the perfection of a system of selective telegraphy whereby messages may be differentiated and only the receiver that it is desired shall receive the message may become responsive to the waves of ether.

The first of these problems may be said to have been successfully solved, and a transmitter devised capable of radiating all the energy generated. The second is believed to be nearing a successful solution. The third is thought to be well demonstrated theoretically, but has not been fully tested in practice.

While there is much experimental work yet to be done before the present system is reliable for intership communication, or before any two systems can work within the same field without each rendering the other useless, such progress has been made by the Government experimenters that, with no interference by private systems, stations can be successfully operated over at least 150 miles of coast line, and they are now in operation on the North Carolina and Virginia coasts, and soon will be instituted between the Farallone Islands and the mainland and Tatoosh Island and the mainland, on the Pacific coast.

THE MERIT SYSTEM AND THE DISCIPLINE OF THE WEATHER BUREAU.

The merit system of the Weather Bureau conforms to the letter of the Civil-Service law and carries its spirit to a rational and beneficent conclusion. The duties of this Bureau are exacting. It requires a strict discipline to administer a service with such extensive ramifications and have every man at his post of duty at exactly the same moment of time, and to do this several times each twenty-four hours, as is necessary in the gathering and the charting of simultaneous weather observations and in the rapid dissemination back to the country of the forecasts and warnings based upon the observations.

A system of merit and discipline has gradually become fixed in the Bureau. The system is fair. It enables honest and efficient officials to

work themselves upward without placing themselves under obligations to anyone. It contributes to a high standard of manly character and to efficiency in public office.

BUREAU OF ANIMAL INDUSTRY.

Our animal industry, which has been most remarkably developed both as to numbers and values, has experienced great prosperity. There has been an active market for animals and animal products at satisfactory prices. In no other large stock-raising country have animals been so free from disease. It is the function of this Department, through the Bureau of Animal Industry, to foster and assist this branch of agriculture by distributing information, by protecting it from both imported and indigenous contagion, by inspecting animals and meats for the interstate and foreign trade, and by certifying that exported meats are wholesome and that animals are free from contagion.

ANIMAL EXPORTS.

Under this intelligent and helpful supervision there were exported last year animals valued at more than $52,000,000, meats valued at more than $113,000,000, animal fats and oils valued at more than $66,000,000, dairy products valued at nearly $9,500,000, and miscellaneous animal products valued at more than $12,000,000. The grand total of animals and animal products exported during the year amounted to nearly $254,000,000.

INSPECTION SERVICE FOR EXPORT ANIMALS.

Out of a total of 459,000 cattle exported, there were inspected, marked with numbers for identification, and certified 385,000. The remainder were shipped in small lots from ports where no inspection is maintained and to countries which do not require inspection. The number of sheep exported reached about 298,000 head, and of these 228,000 were inspected before shipment. The horses and mules constituted the second largest item in the exports of live animals, the number being 116,500 and the value about $8,900,000. Of these, nearly 48,000 were inspected and certified. There was a notable increase in the number of cattle and sheep exported, the former being greater than any year since 1898 and the latter the largest since 1896. There was a decline in the exports of horses.

The inspection of steamships which is made in connection with the inspection of export animals has been conducted with a view to securing strong and reliable fittings properly fastened to the decks, adequate ventilation, alleyways sufficiently wide to enable attendants to perform their duties in all kinds of weather, and, in general, such arrangements and management as would insure humane treatment and

land our animals in the best condition for market. The percentage of loss in ocean transit has been reduced to 1.72 for horses, 0.91 for sheep, and 0.24 for cattle. During the past year notable improvements have been obtained in the ventilation and width of alleys, and it is believed that the losses have reached almost the lowest attainable point. The number of clearances for vessels which were inspected and passed was nearly 1,000.

INSPECTION SERVICE FOR IMPORT ANIMALS.

In order to prevent the introduction of animal plagues an inspection service is maintained at our principal seaports and along our frontier. Quarantine stations have been established for animals coming from countries where contagious disease exists. There were quarantined at these stations during the year 559 cattle, 525 sheep, 81 swine, and 118 animals for menageries and zoological parks. There were also admitted, after inspection and in some cases quarantine, over 242,000 animals from Canada and about 100,000 from Mexico. The examination of this vast aggregate of imported animals, amounting in all to over a third of a million, is a most responsible task, but so far it has been successfully conducted, and none of the exotic plagues of the domesticated animals has been allowed to reach our territory. With our enormous investment in animals that are susceptible to such plagues, it is clearly a duty which the Government owes to our stock raisers to maintain this inspection and quarantine with the utmost rigidity. The ravages of the rinderpest as it is sweeping over the African Continent should be an object lesson indicating the terrible destruction which such a disease would cause among our immense herds of valuable stock.

The tremendous possibilities of loss from imported contagion suggest that possibly the time has come when it might be well for us to consider whether it would not be best for us to follow the example of Great Britain and exclude entirely live stock from other countries. Inspection and quarantine, however carefully and conscientiously performed, are acknowledged by most countries to be only a relative and not an absolute guaranty of protection. Should not our animal industry have the most complete safeguards thrown around it which the experience of the world has shown to be required for the most absolute and perfect protection? In this connection, we are reminded that some of the territory which has recently come under our flag is believed to be infected with animal plagues and parasites unknown to the United States, and that may work great injury if they are transported to our soil. It would appear to be wise for such legislation to be enacted as would provide against animals from this territory being allowed to enter our ports, whether these animals are brought by individuals or returning troops.

TUBERCULIN TEST FOR IMPORTED CATTLE.

The reported increase of bovine tuberculosis in most countries, and the losses already sustained from the disease in the United States, led me to make an order requiring a tuberculin test of cattle imported for breeding or dairy purposes. The application of this test has detected a sufficient number of diseased animals to fully justify its adoption. In fact, more animals have reacted than was anticipated, and in order to save importers from heavy loss it has been necessary to provide for this test before animals cross the frontier from Canada, and to send an inspector to Great Britain to make the tests and reject affected animals before shipment. In the tests which have been made it is not believed that any animals have been injured by the tuberculin or that any have reacted which were not tuberculous. The welfare of the live-stock interests requires the continuance of this method of inspection.

MEAT INSPECTION.

The meat-inspection service has grown to proportions commensurate with the live-stock industry. It is now maintained in 51 cities and at 156 abattoirs. Nearly 37,000,000 animals were inspected at time of slaughter. This is an increase over the preceding year of 6 cities, 8 abattoirs, and 2,300,000 animals. Although in the aggregate a large number of carcasses were condemned, the percentage has been extremely small. In nearly 5,250,000 cattle inspected the condemned carcasses amounted to only about one-fourth of 1 per cent; in 6,500,000 sheep it was about one-tenth of 1 per cent, and in 24,250,000 hogs it was but one-third of 1 per cent.

The larger part of the inspected meat, as might be anticipated, went into interstate commerce and was consumed in the United States, but there were exported under Department certificates 452,830,373 pounds of beef, 894,648 pounds of mutton, and 231,144,938 pounds of pork. The microscopic inspection of pork was maintained during the year, but owing to the comparatively high prices in this country there was a considerable decrease of exports in this line of products, but 35,942,404 pounds having been certified for countries requiring such inspection.

CONTROL OF INDIGENOUS DISEASES.

There are a few diseases which are more or less distributed over our territory and which require constant supervision and control. One of the most important is Texas or malarial fever of cattle. This disease, owing to the thorough knowledge of it which has been developed by our investigations, no longer has terror for our stockmen. The thorough control now exercised over cattle shipments from the infected area is an almost complete protection, but it must be kept in constant operation to be successful. Nearly 1,500,000 inspections were made

in this service, and 45,400 cars were disinfected. It is hoped through intelligent effort to considerably reduce the area now infected with this contagion.

Much attention has also been given to the repression of scabies in sheep. The number of animals inspected in this service was nearly 8,000,000, and over 1,000,000 were dipped in a proper liquid for the cure or prevention of the disease under the supervision of our inspectors. The effect of the regulations bearing upon this disease has been remarkably beneficial, the number of diseased sheep reaching the markets of the country having been greatly reduced.

One of the most common diseases of cattle is known as blackleg—a malignant and fatal swelling which appears frequently in one of the limbs, causing great discoloration of the affected parts. The only means of combating this disease is by vaccination, and to assist our stock raisers more than one and a half millions of doses of the vaccine have been distributed. This is an increase of more than 50 per cent over the previous year. The demands for this vaccine have been most urgent, and it is evident that its preparation and distribution have been of great benefit. The reports show that the losses have been reduced to less than 1 per cent in affected herds, whereas formerly they were in most cases 10 per cent or more.

Tuberculin and mallein have also been prepared and distributed to State and other local authorities to aid them in detecting tuberculosis in cattle and glanders in horses. The assistance thus rendered has enabled much work to be done locally for the control of these diseases which otherwise would not have been possible. More than 44,400 doses of tuberculin and 7,000 doses of mallein have been thus supplied.

There are several lines of work which might still be taken up with much benefit to stock raisers in certain sections of the country. Cattle for improving the blood of the herds of our Southern States can only be taken there safely after inoculation with the germs of Texas fever. The Missouri Agricultural Experiment Station has had the enterprise to undertake the inoculation of cattle which the breeders of that State desired to ship to the infected area, and the Texas station has also done good work along this line. It was first shown by this Department that such inoculation was a practicable method of prevention, and in the interest of the large section of the South which needs inoculated stock and at present can not obtain it the Bureau of Animal Industry should undertake to thus treat animals which are intended for interstate shipment. There has also been witnessed a considerable outbreak of anthrax in the southern Mississippi Valley, and the Department has been unable to give aid, notwithstanding most urgent appeals. This disease may likewise be prevented by a reliable vaccine, but the facilities and appropriations now available will not permit this work to be undertaken.

PATHOLOGICAL INVESTIGATIONS.

Investigations of numerous diseases have been in progress. Much work has been done with a view to the discovery of some more effectual method of controlling hog cholera than has yet been devised. Tuberculosis has been investigated to learn more about the proportion of affected animals which produce infected milk, and to determine whether bovine tuberculosis is communicable to man. Other interesting and important diseases of horses, cattle, sheep, and poultry have been investigated in order to assist the inspection service in its work or to grant relief in outbreaks to which the attention of the Department has been called. In the treatment and cure of parasitic diseases of sheep and of an eruptive skin disease seriously affecting the heads of these animals, valuable discoveries have been made, which are immediately available for the relief of the sheep industry. Other discoveries as to the nature of several diseases have been made which can not be described at this time.

STATE RESTRICTIONS ON THE INTERSTATE LIVE-STOCK TRAFFIC.

Inspection laws and regulations are enforced in a few States, which duplicate the inspection made by the Bureau of Animal Industry of animals which are shipped from one State to another. In addition to the inspection, some of the States demand inspection fees which constitute a serious burden on this branch of interstate commerce. This inspection and tax is not confined to cattle which are certified by the Federal inspectors and which are destined for the State making the inspection, but in some cases has been applied to animals simply shipped across the territory of a State and destined for some other section of the country. The enforcement of such a policy is contrary to the interests of the country as a whole, and is a reversion to the system of taxing interstate traffic, which became so vexatious in the period before the adoption of our Constitution. If generally sanctioned by the States it would prevent the marketing of live stock from some sections; it would absolutely prohibit shipments across the country, as from Massachusetts to California, and it would destroy much of the usefulness of the Federal inspection and certification, which has become of such value and which has been established by Congress to insure fair treatment and facility of shipment to all sections of the country. So menacing is the present situation to the great cattle industry of the Southwest and West that I have requested the Attorney-General of the United States to cooperate in bringing the matter promptly before the Supreme Court for decision as to the constitutionality of these State laws. It is a matter for congratulation that this request has been favorably received and that the assistance of the Department of Justice is promised, with a view to obtaining an early adjustment of this serious question.

BUREAU OF PLANT INDUSTRY.

The Bureau of Plant Industry was one of four Bureaus organized during the year in accordance with an act of the last Congress. The advantages of bringing together the allied lines of work in the Department were pointed out in my last report, and already good results have been secured by following the policy there laid down. Congress authorized the bringing together of the plant physiological and pathological investigations, the botanical investigations, the grass and forage plant investigations, the work on pomology, and the experimental gardens and grounds; and during the year the Arlington experimental farm, the investigations in the production of domestic tea, the work on foreign seed and plant introduction, and the Congressional seed distribution have been added by executive order, making nine branches in all. The unification of work and the advantages resulting from close cooperation and perfect elasticity to all branches composing the Bureau as at present organized prompt me to urge that Congress take proper action toward broadening all lines, as provided for in the estimates for the next fiscal year. As at present constituted the Bureau has a corps of more than 200 efficient workers, and nowhere else in the world are so many important plant problems being studied. The past year has been marked by important advances along many lines, a few of which may be noted here.

PLANT PHYSIOLOGY AND PATHOLOGY.

The field of plant physiology and pathology is an exceedingly broad one, involving, as it does, a study of normal plant life on the one hand and abnormal conditions on the other. Although this work is comparatively new, its advances have been rapid, especially during the past three or four years, largely as a result of the work done by the Department. The great aim of all this work is to make it reach the farmer, and to do this it is essential that the practical features should always be kept in mind. Following are some of the practical results obtained in the past year, showing the bearing of this work:

WORK ON COTTON DISEASES.

Cotton is subject to many serious diseases, some of which cause immense annual losses. These losses are not evenly divided, but fall with crushing effect upon individual growers and communities. In the sea-island region, where the fine grades of sea-island cotton are produced, hundreds of acres, including many fine farms, have been rendered worthless for cotton by a disease known as wilt. This is due to a fungus parasite in the soil, which for several years has been spreading slowly but surely throughout the cotton areas of the Southeast. Every attempt to kill this fungus in the old way, by treating

the soil and plants with fungicides, failed, hence attention was turned to the problem of obtaining a form of cotton which, through its own inherent vitality, would be able to resist the disease. The clew to this had already been noted in the fact that individual stalks here and there in a field of cotton would resist the attack, and this suggested the plan of selecting seed from such resistant stalks, thus gradually securing a form which would be immune. This has been accomplished, and it is planned to extend the planting of the resistant sorts as rapidly as the work can be pushed.

In this connection, another interesting and valuable discovery has been made in the matter of securing also a resistant cowpea. The cowpea is used in rotation with cotton, and it was also attacked and killed by the same fungus which destroyed the cotton roots. The securing of a resistant cowpea will make it possible for the growers of the fine sea-island cotton to bring back their land to its once high value.

DISEASES OF ORCHARD FRUITS.

The peach in this country has generally been a very profitable crop, but for many years it has been subject to a number of serious diseases. Some of these can now be controlled, notably "yellows" and peach-leaf curl, two of the worst enemies of peach growers. A few years ago a new disease appeared in some of the finest peach orchards of New York, Michigan, and other States, and this trouble has caused growers a great deal of uneasiness. The Department has had one of its most competent experts engaged on the disease, and he believes that he has discovered the cause. The disease in question is known as "little peach," from the fact that the fruit ripens when very small, this symptom becoming more pronounced each year until the tree dies, which it invariably does at the end of two or three years. The cause of "little peach" is believed to be a fungus which attacks the very young roots, and already the matter of preventing it by securing resistant stocks has been taken up.

DISEASES OF FOREST AND CONSTRUCTION TIMBER.

The losses due to the rotting of forest timber and timber used for construction material, such as railroad ties, bridge sills, etc., have been great, and an increasing demand has been made for information that would lead to more light as to the best methods of preventing such losses. During the year a thorough investigation of this subject was inaugurated, the work being undertaken in cooperation with the Bureau of Forestry. An expert was sent to Europe to secure information as to the methods employed in controlling timber rots there, and extensive experiments were inaugurated to determine the best methods of preserving construction material and the prevention of diseases in standing timber.

PLANT-BREEDING WORK.

The breeding of plants for the purpose of obtaining forms resistant to disease and better adapted to the new and changed conditions which are constantly arising is rapidly becoming an essential feature in agriculture. Attention has already been called to the work of securing strains of cotton resistant to wilt and other diseases. The remarkable success of these experiments indicates the importance of this phase of plant-breeding work. Some new strains of upland cotton were also secured by hybridizing the short and long staple cottons. One of these hybrids in particular is said by experts to be superior to any upland cotton now grown. Numerous other valuable hybrids and select strains have been developed, and these are being tested and their characteristics fixed. A hybrid between one of our American upland cottons and an Egyptian variety promises to be greatly superior to either parent.

For several years the Department has been working to secure, by breeding, a race of oranges resistant to frost. It was proposed by this means to restore the orange groves of Florida, which formerly produced several million dollars' worth of oranges yearly, but were nearly all destroyed by cold a few years ago. Twelve of the new evergreen hybrid oranges, secured as a result of crossing the hardy Japanese form with the Florida sweet orange, have proved to be the hardiest evergreen oranges known in the world. Southern nurserymen have pronounced them to be of great value as hedge plants, entirely apart from their fruit-bearing value. There is great promise, however, that we will ultimately secure a fruit that is hardy and of good quality. Some of the hybrid raisin grapes, produced with a view of securing resistance to a disease known as "coulure," or dropping of the fruit, have borne for the first time. These vines have proved hardy so far and have produced fruit of remarkably fine quality. Some of the vines appear to be resistant to a serious and destructive root disease which has appeared in California, and they may resist the worst of all Pacific coast grape diseases—the so-called "California vine disease."

A serious problem which for many years has confronted the farmers of the West is the securing of plants resistant to the alkali soils of that region. Wherever agricultural crops are being grown there has been more or less adaptability of plants to the peculiar conditions existing in many parts of our Western country, and as a result some plants are found to give much better yields on certain soils than others, mainly through their ability to resist the large amount of alkali present. In connection with the breeding work important investigations have been inaugurated looking to the development of resistant plants of many kinds, special attention being given to the forage crops, as these are of great importance. In this connection cooperation has been secured with the Bureau of Soils, whose work during

the past few years in the West has brought about a much better understanding of some of the important questions concerning the agricultural development of that region. Other important lines of work in the matter of plant breeding have to do with cereal improvement, but these will be more fully discussed under "Introduction of seeds and plants."

NITROGEN-GATHERING BACTERIA.

Nitrogen is one of the most costly and probably the most important of all plant foods. So valuable is this material and such is the demand for it that already it has been predicted that it is only a question of a few years until the commercial supply will be exhausted. Recently, however, attention has been turned to the bacteria which develop nitrogen in connection with the roots of clover, beans, and many related crops. A new method of cultivating and obtaining these organisms in large quantities for distribution with leguminous seeds has been discovered, and will be perfected and put into practical use during the coming year. This, it is believed, will make it practicable to grow many leguminous crops where, owing to the lack of proper organisms, they have refused to grow in the past. It will also make practicable the use of a large number of legumes for gathering nitrogen.

BOTANICAL INVESTIGATIONS AND EXPERIMENTS.

The botanical investigations and experiments conducted by the Department have led to many valuable discoveries, and from year to year their great practical value is being recognized more and more. The work being done on seeds, improvement of crops and methods of crop production in our tropical possessions, and prevention of the great losses of cattle in the West through the eating of poisonous plants is of special interest. The following are some of the more striking results of the work done under this head during the past year:

NEW FACTS CONCERNING KENTUCKY BLUE-GRASS SEED.

The Department of Agriculture has for a number of years past purchased considerable quantities of Kentucky blue-grass seed for Congressional distribution. Since the practice was inaugurated of making germination tests of all the seeds distributed it has been found that Kentucky blue-grass seed, as offered in the open market, could not be secured ordinarily of a higher germination than 50 to 60 per cent. On the other hand, it was found possible, by special purchase, to secure seed showing a germination of 90 per cent and more. These facts suggested an investigation of the causes of the low germination of ordinary commercial samples. It has been found that in harvesting this seed the tops of the grass are stripped from the growing plants

when green and piled in windrows. In this stage, unless great care is taken in turning and airing the mass, a heating takes place in which the temperature rises sometimes as high as 173° F. The tendency of this heating is to destroy the germination of the seed. This fact is readily applied, even under the methods of handling the grass seed which are now followed in the areas where it is grown. In order, however, to secure the most practical results, the Department is now engaged in experimenting with machinery which will dry the moist seed without permitting it to heat, and at the same time without destroying its germination in any other way. There is good prospect that suitable machinery will be found.

SECURING A STAND OF BERMUDA GRASS FROM SEED.

One of the most valuable pasture grasses for use in the Southern States is Bermuda grass, a species of tropical origin. In our latitude this grass seeds very sparingly, and the method of securing a field of it has been to transplant roots. This method, however, is so expensive as to be almost prohibitory. Experiments have been made with good imported seed by the Department during the past two years on the trial grounds at Washington, and it has been found that when sown at the rate of 3 pounds per acre during a portion of the year in which the ground continued moist, a good stand from 3 to 6 inches high was secured in forty-five days. The procuring of good germinable seed and the adaptation of the above facts to conditions in the South should make it possible to secure at a moderate price an excellent stand of this valuable grass.

SUPERIORITY OF AMERICAN-GROWN CLOVER SEED.

Owing to a controversy in Europe regarding the relative value of American and European clover seed, the Department has undertaken some comparative experiments, the initial series of which was conducted at Washington. Many samples of clover seed of known origin from the different countries of Europe and from different parts of the United States and Canada were grown under like conditions. Cuttings of hay were made at suitable intervals, the product of each plat being carefully weighed. These experiments, which have now been under way for two years, show conclusively that under the conditions existing here the European red clover is decidedly inferior in productiveness to the American. Apparently the American strain is better adapted to the conditions of bright sunshine, periodic heat, and dryness that exist here. For the purposes of our farmers, therefore, a decision of the question whether to use American or imported seed is easily reached. During the past year a series of supplementary experiments has been started at typical selected areas in different parts of the United States, to see whether these results hold in the principal clover-growing States.

A REMEDY FOR STOCK POISONING.

The loss of stock in Montana, caused by poisonous plants, has been estimated at from fifty to one hundred thousand dollars per annum. Prior to the present fiscal year there was no simple and reliable way of saving stock when poisoned, but now, by a series of careful experiments conducted at the request of the Montana authorities, the Department has shown that if a small tablet consisting of permanganate of potash and sulphate of aluminum be promptly administered the greater part of this loss can be averted. The action of the permanganate is to oxidize and destroy the poison still remaining unabsorbed in the stomach, and this action is intensified by the sulphate of aluminum. The poisonous plants that respond to this treatment are, so far as ascertained, larkspur and poison camas, the two plants that cause most of the losses in Montana.

STUDIES OF AMERICAN FIBER PLANTS.

The Department's work with Egyptian cotton, outlined in my previous report, has produced very encouraging results, and it is now believed that it can be successfully grown in this country. As early as 1892 the Department imported and distributed seed of some of the choice Egyptian sorts, but owing to lack of money the matter was not followed up. Recently, however, considerable seed has been imported, and the outlook for the growth of this cotton is much more encouraging. Additional facts in regard to what has been accomplished in this line will be given under "Introduction of seeds and plants from foreign countries." Some very encouraging results have also been obtained through our studies of hemp, especially in regard to imported kinds, and particularly those from Japan.

TROPICAL AGRICULTURE.

The acquisition of tropical territory by the United States has made it important and necessary that the Department become thoroughly familiar with the agricultural conditions prevailing in these lands, and their possibilities in crop production, (1) for the purpose of supporting the present population; (2) for supporting the population which will result from the new and changed conditions, and (3) for bringing in revenue from outside sources. The United States pays out millions of dollars annually for tropical products which we ought to grow, and which we can grow without interfering in any way with well-established industries. Coffee, rubber, bananas, cacao, and many other tropical crops not hitherto grown by us can now be produced, and attention has been turned to the best methods of succeeding with such crops.

It is evident that for many years the Department will have to keep in close touch with whatever work may be inaugurated in these outly-

ing lands; hence, experiment stations established there must be so organized as to be an integral part of the Department. In order to do this the stations should be put in charge of men from the Department who are familiar with existing conditions and whose knowledge will render them strong supporters of the Department's work. This policy has already been carried out in the case of the stations established in Hawaii and Porto Rico. The tropical work proper of the Department, therefore, will be along the lines already laid down, and wherever practicable will be carried on in cooperation with the stations established, whose energies, for a number of years at least, must be devoted to matters more or less local.

The improvements in the coffee industry of Porto Rico are an example of what has already been accomplished in this direction. Among the agricultural imports of the United States, coffee is second only to sugar, our annual importations averaging $70,000,000, and only a small fraction of 1 per cent of this quantity comes from our tropical islands. The most important industry of Porto Rico, however, is the raising of coffee for European markets; hence, it has received early attention in our investigations of tropical agriculture. It has been found that the Porto Rican coffee plantations are seriously injured by being too heavily shaded, and also that shade is not, as commonly believed, a necessity, the supposed good effects resulting from it consisting simply in the fixation of nitrogen in the soil by the root tubercles of the leguminous trees used for shade. The other advantages of shade are only indirect, consisting in the protection of the soil from heat, drought, and erosion. Rational moderation in the use of shade, the raising of seedlings in nurseries, and other practical cultural improvements would double or treble the island's output of coffee, and with the increase of acreage readily possible for this crop the island could be made to produce more than half of the coffee consumed in the United States. The work now under way is planned to bring this about, and encouraging results have already been obtained.

GRASS AND FORAGE PLANT INVESTIGATIONS.

The problems involved in the investigations of grass and forage crops are some of the most important that to-day confront the American farmer. As population increases and competition in all lines of agricultural work becomes keener, the need becomes strongly felt for more light on such important questions as: How to restore the great ranges of the West; how to maintain our pastures; how to meet the trying conditions in the South and semiarid West in supplying food for stock, etc. The work of the Agrostologist is conducted with a view to solving these problems, and already very encouraging and promising results have been obtained, some of which may be referred to here.

RANGE IMPROVEMENT.

The loss to the cattle interests of the West during the past fifteen or twenty years, as a result of injudicious management of ranges, has been heavy. In order to obtain some information as to the possibility of restoring these overstocked lands, experiments in regrassing were undertaken at Tucson, Ariz., in cooperation with the agricultural experiment station, and at Abilene, Tex., with Mr. H. L. Bentley, employed by the Department for this work and living at that place. At Tucson a small area of land was secured for the experiments, the ground having been previously denuded of grass through overstocking and mismanagement. Very promising results have already been obtained in connection with this work, it having been shown that by comparatively simple and inexpensive methods much can be done toward bringing the ranges back to their original condition. The experiments at Abilene, a report on which has been prepared, have demonstrated conclusively the possibility of greatly improving the cattle ranges by practical methods and at comparatively little cost, the stock-carrying capacity of the range lands selected for the experiments being doubled in three years. Mr. Bentley claims that it is not only possible to restore the worn-out and grass-denuded ranges to their former productiveness, but that while this is being done cattle may be pastured on them and the number increased from year to year as the capacity of the pastures to sustain them is increased.

Widespread interest in this work has been aroused, and so great has been the demand for its extension that an estimate for additional appropriations to carry on the investigations has been made. I earnestly recommend that the increase asked for be granted, and, furthermore, that action be taken by Congress giving you, Mr. President, authority to secure for the experimental needs of this Department such tracts of public range lands as may be necessary for the best interests of the work.

GRASS GARDENS.

Nothing is more instructive to visitors than to see grasses and forage plants growing, and for this reason considerable time has been devoted to developing the gardens at Washington, and at Buffalo in connection with the Pan-American Exposition. In these gardens the cultivation of ornamental grasses and of grasses suitable to lawns was specially undertaken for the information and guidance of those interested in beautifying the home. More than 300 varieties of grasses and forage plants have been brought together in the gardens at Washington, and many interesting and valuable results have been obtained through a study of their behavior under the conditions of climate and soil prevailing here. A feature of the Pan-American Exposition was the Department's exhibit of growing grasses and forage plants. This exhibit was located near the Government building and attracted wide-

spread interest and attention from the first. As the season advanced and the characteristics of the different grasses became manifest, dairymen and farmers from all sections of the country visited the plots and were much interested in the object lessons they taught.

A unique feature of this exhibit was a display of the sand-binding grasses, the object of this being to illustrate how vast tracts of land along our seacoast may be made profitable at comparatively small expense. A miniature sand dune was produced artificially, and on it were planted the common beach grass of the Atlantic coast north of Virginia, sand millet of the coast of Virginia southward, the sea lyme grass from the coast of Oregon, long-leafed sand grass from the lake shores, and other sand-binding types. Naturally these grasses are never found except in drifting sands, for the fixing of which they are well adapted. Altogether this work has done much to show in an instructive way many interesting features of the grass and forage plant investigations.

COOPERATIVE WORK WITH EXPERIMENT STATIONS.

Another important feature of the work of the Agrostologist during the year was the formulation of a plan for conducting experiments with grasses and forage plants in cooperation with the experiment stations. Formal articles of agreement, setting forth the objects of the experiments, the respective features of the work to be assumed by each party to the agreement, and the manner in which the results obtained may be used by each, were drawn up and the agreement signed by the proper officials of the Department and the stations. In some cases the Department assumed a part of the expenses connected with the experiments, while in others it simply furnished the necessary seed and expert services in preparing the plans.

In arranging for the work care was exercised in each case to select a station in the locality where the solution of the particular problem to be taken up seemed most important, and where the best facilities were provided. The plans have met with general approval, and already cooperative experiments are being conducted with 13 stations. The problems taken up have widespread application, and the results so far obtained lead to the belief that great good is to come from the work as a whole.

POMOLOGICAL INVESTIGATIONS.

The fruit interests of this country have grown to enormous proportions, and the pomological work of the Department is designed to promote them in every way possible. With this end in view, a large exhibit was last year maintained at the Paris Exposition, the object being chiefly to encourage a demand for American products. The beneficial effects of this work are already showing in the increased demand for American fruits, especially oranges and apples. In 1899 the

United States exported 380,222 barrels of apples, valued at $1,210,459. In 1900 526,636 barrels were exported, valued at $1,446,555. Already in 1901 855,673 barrels have been exported, valued at $2,058,964. The value of the oranges exported in 1901 is double that of 1900, all of which can largely be traced to the interest aroused by the work at Paris.

EXTENSION OF FRUIT MARKETS.

In order to open up additional markets for our fruit and to bring about better methods of harvesting, packing, storing, and shipping the same, a small fund was secured for the present fiscal year, and the results accomplished with this encourage the belief that there are great possibilities for trade in American fruit abroad. Trial shipments of pears, peaches, and other fruits have been inaugurated with such encouraging results that it is believed the work will be undertaken next year on a commercial scale by private interests. With the unrivaled facilities America possesses for growing the finest fruits, and with a clear understanding as to the proper methods of handling, there is no reason why a fine foreign trade should not be developed.

ENCOURAGING THE PRUNE INDUSTRY OF THE PACIFIC COAST.

The prune industry of the Western States has grown to large proportions, but in order to compete with foreign trade the need has long been felt for a better knowledge of methods of growing and handling the crop and the best varieties to plant. By an arrangement between the Pomologist and the Botanist an agent was sent during the year to France to study the prune industry there. The work of this agent resulted in the discovery and introduction of several important varieties that promise to be of value in the Pacific Northwest.

GROWING EUROPEAN GRAPES IN THE SOUTH.

The United States imports every year large quantities of European grapes, which are sold mostly for table use. It was believed that some of these varieties could be grown in the South, and to test the matter a number of plantings were made there three years ago. These grapes fruited one year ago, and the indications are that some of the varieties will be found valuable for our markets.

EXPERIMENTAL GARDENS AND GROUNDS.

Under the new arrangement through which the experimental gardens and grounds became a part of the Bureau of Plant Industry, plans have been made for using them in connection with nearly all lines of work. The greenhouses and conservatories prove valuable for the propagation of many useful plants secured by the agricultural explorers and others. Much has been done during the year toward

increasing the valuable collections already on the grounds and propagating and disseminating to nearly all parts of the country rare forms which have proved valuable. A part of the force of the gardens has been employed in gathering seeds of rare trees and other plants, and from them growing seedlings for distribution. The cultivation of plants under glass is rapidly assuming important proportions, many millions of dollars being annually invested in this work. There has long been felt the need of careful experiments to determine methods of growing such crops and improving them. To this phase of work special attention has been devoted, and already promising results have been obtained.

THE ARLINGTON FARM.

This farm, which was placed at the disposal of the Department two years ago, consists of about 400 acres of rolling land, and, as a whole, is very well suited for the purposes set forth in the act. The appropriation available has been devoted to getting the ground into shape, and already marked improvements can be noted. A large part of the preliminary rough work, such as clearing, draining, etc., has been accomplished, and the general plan of getting the land into condition for planting, preparatory to inaugurating experiments, has been perfected. The farm can be made a valuable adjunct of the Department, and will be so managed as to give opportunity for conducting practical experiments in many lines of work. The shaping of a general plan with this object in view is necessarily slow, as each step must be carefully considered. Buildings will soon be needed, and recommendations have been made to this end.

PRODUCTION OF TEA IN THE UNITED STATES.

The production of several kinds of tea in the United States is now an assured fact, and in addition to this it is encouraging to be able to announce that experts who have examined the tea produced here this year pronounce it equal in flavor and aroma to the best imported teas. As pointed out in my previous report, the profit in this crop averages from $30 to $40 per acre net. During the year Dr. Charles U. Shepard, of Summerville, S. C., has been in charge of the Government work, conducting it in connection with his large tea gardens at the place mentioned. This year Dr. Shepard produced about 4,500 pounds of high-grade tea, for all of which a ready market was found in the North. During the year Dr. Shepard perfected a machine for the manufacture of green tea, and has very generously placed this under the control of the Department, so that those wishing to use it may do so without paying royalty.

Capital is always timid of investments in new enterprises of this kind, and there is still much to be done to demonstrate the possibilities

of the work in other parts of the South. The labor problem is an important one, but Dr. Shepard has shown his ability to handle it, and with his aid the Department is now training a few young men in the technique of the work. The extension of the industry in the South and studies for the purpose of improving the quality of tea will be pushed as rapidly as the moneys at hand will permit. There are thousands of acres of land and thousands of idle hands that might be made available for this work, and our possibilities in this field should not be neglected. The United States imports from $10,000,000 to $12,000,000 worth of tea every year, and, although it may be a long time before anything like that amount can be produced in this country, the industry should be encouraged in every possible way.

INTRODUCTION OF SEEDS AND PLANTS FROM FOREIGN COUNTRIES.

The act of Congress establishing the Department of Agriculture specifically provides for the introduction and dissemination of rare and valuable seeds. More or less of this work has been carried on for forty years, but recognizing the needs for enlarged and systematic efforts along this line, steps were taken three years ago which led to a great increase in the Department's opportunities in this direction. Briefly stated, the object of this work is to encourage the building up of home industries and thus save the American people large amounts annually sent abroad. With our vast resources and variety of climate and soil, and a people who are never daunted by the difficulty of an undertaking, the possibilities of developing new fields seem unlimited. In probably no branch of the Department's work can the practical value of its efforts be more quickly shown than in this line. Some of the results achieved the past year are set forth below, and a study of these will show in what manner new industries may be developed.

DEVELOPMENT OF THE RICE INDUSTRY.

In my last report attention was called to the fact that the introduction of Japanese rice resulted in an increased production, amounting to at least $1,000,000, of this commodity in Louisiana, and furthermore, that the impetus given to the work in Louisiana and Texas led to the investment of not less than $20,000,000 in the industry. In 1900 about 8,000,000 pounds more rice were produced than in 1899, and this year 65,000,000 pounds more were produced than in 1900. With the rapid increase in our own production the importation of rice from foreign countries is falling off, as shown by the fact that in three years the imports have decreased from 154,000,000 pounds to 73,000,000 pounds. All the increase in home production can not, of course, be ascribed to the Department's introduction and distribution of Japanese rice, but the great impetus to its production in this country was

given by the Department's introduction three years ago. Evidently it will be but a few years until the United States will not only grow all the rice consumed here, but will export part of the product as well.

MACARONI WHEATS.

The United States imports over 16,000,000 pounds, nearly $800,000 worth, of macaroni annually. This product is made from a special class of wheats, which, until recently, had never been given a thorough trial in this country. The Department secured a quantity of the wheats, and it has been found that they are well adapted to a wide extent of territory in the West and Northwest. During the last two years they yielded one-third to one-half more per acre than any other wheats grown side by side with them, and in 1900, when other wheats were almost a complete failure in the Dakotas, the macaroni varieties produced a very good yield, and the grain was of excellent quality. They have also been very successfully grown in Kansas and Nebraska. The results of last season's work show also that a high quality of grain of this class can be produced.

The Department has made every effort to bring the producers and buyers of this class of wheat together, with the result that the demand for it now more than equals the supply. Moreover, certain companies are now for the first time offering for macaroni wheats, which include the well-known Wild Goose that was heretofore invariably rejected in the markets, about the same price as is paid for No. 2 Northern. There is a demand for carload lots of macaroni wheat for seed as well as for milling. Our own factories for making macaroni are awakening to the importance of using these special wheats instead of the ordinary bread wheats, and the demand for macaroni flour for this purpose is already greatly in excess of the supply. Besides the home demand for these wheats there is a good market abroad.

The building up of the macaroni industry, which has been carried on as a part of the pathological and physiological investigations, shows the importance of concentration of effort on a single crop. With the factories ready to take the wheat and to make from it macaroni equal to the foreign article, it will not be long before the $800,000 sent abroad can be kept at home.

NEW FORAGE CROPS.

For many years there has been an urgent demand for some good grasses and forage plants for the States of the Great Plains, especially for the Northern States, where the winters are so cold and dry that ordinary forage plants are killed out. This demand has been met to a great extent by the importation of the smooth brome grass (*Bromus inermis*), as stated in last year's report. This grass comes from

Russia and Hungary, and has proved to be most excellent for pasture and hay, being perfectly hardy as far north as North Dakota. A hardy alfalfa imported from Turkestan has also proved valuable, being far more resistant to cold and drought than those ordinarily grown and which came originally from much less rigorous climates.

HOPS AND BARLEY.

Although hops have been grown in this country for a great many years, they have always been inferior as compared with the best European hops, and as they bring a lower price in the market and are not so desirable as the Bavarian hops, cuttings of the best of the latter were imported last year. These cuttings have been placed in the hop-growing districts of the United States, and promise to be far superior to the ordinary varieties grown, in addition to maturing earlier and extending the picking season.

American barleys are also inferior to the Bavarian barleys, being too nitrogenous and not sufficiently starchy. The ordinary varieties grown in America are the six-rowed and the four-rowed kinds. The two-rowed kinds of Europe are superior for some uses. The Department therefore imported last year for experimental purposes, in addition to the hops, a quantity of the best Bavarian barleys, and these are now being tried in this country. It is hoped that by growing this improved barley, as well as the superior varieties of hops, the importation of large quantities of some articles of commerce will be done away with.

AMERICAN-GROWN EGYPTIAN COTTON.

Approximately $8,000,000 worth of Egyptian cotton is imported into this country every year, there being a special demand for this cotton on account of its high quality. The Department imported some seed of this cotton several years ago, but more recently larger quantities were obtained and placed where the variety seems likely to succeed. Very encouraging results have been obtained from the work, and this year a bale of Egyptian cotton, grown from imported seed in southern Georgia, was given a thorough spinning test in a mill in Connecticut, and was pronounced equal to the best imported grades. It is believed that we can grow this crop, but aside from this the cottons themselves will be valuable in breeding forms which in all probability will prove better than their parents.

AMERICAN DATES.

Another importation which will probably in time prove of great value to the southwestern part of the country is that of date palms obtained in Africa. A number of years ago a limited importation of these palms was made from Egypt, and, while most of them were lost through adversity of climate, the shipment helped to show the possi-

bilities of date growing in Arizona and southern California. Through agents of the Department a small shipment of date palms was secured from Algeria in 1899, and a large shipment from the same country, mostly from the borders of the Sahara Desert, in 1900, and fully 90 per cent of these are growing vigorously. This year a collection of the choicest varieties in Egypt has been obtained and sent to the Southwest, this importation being in continuation of the plan to obtain from every part of the world where the date palm is grown a complete collection of the choice varieties.

The date palm is of special value in the hot Southwestern country, since it thrives and fruits best where the summers are long and hot, as in Arizona and California. The establishment of the industry in this section, therefore, would make it possible to utilize much of the land there which, though irrigable, is too alkaline for ordinary crops. It is hoped, now that a large number of plants of the choicest varieties have been imported, that in time this country may produce enough dates to supply the home demand and, perhaps, even some for export.

CONGRESSIONAL SEED DISTRIBUTION.

Congress has assigned to this Department the duty of purchasing and distributing seeds and plants, and in order that there may be no question as to how and when this shall be done, the law in regard to it is made very specific. I have endeavored to meet the wishes of Congress in this matter in every way possible, and to the best of my ability have secured seeds of as high character as could be obtained under the conditions under which we work. Notwithstanding all precautions, however, the system of securing seeds through a contractor is apt to cause trouble, not so much on account of the likelihood of having inferior seed furnished, as of the contractor's inability to furnish the varieties called for, owing to the quantity required. This was especially the case the past year, and so many complaints were received in regard to this and other points pertaining to the work that I ordered a thorough investigation by the Chief of the Bureau of Plant Industry, in whose charge the entire matter has been placed. No settlement has as yet been made with the contractor for last year's seed, and none will be made until every requirement of the contract has been fulfilled. No matter what the issue, the Department is fully protected on every point.

Although the amount to be expended for seed for the forthcoming distribution is double what it was last year, the work has been so systematized that no apprehension is felt as to our ability to send out all seeds on time. As soon as it was known how much would be available for the work, immediate steps were taken to get all the preliminaries arranged, and as a result the schedule, which provides that the distribution shall begin December 1 and end March 1, will be carried out to the letter.

In the distribution of the vegetable seed through a contractor three important essentials are provided for; that is, (1) the seeds must be true to name; (2) they must have a high vitality, and (3) they must be free from mechanical impurities. The scientific staff of the Bureau of Plant Industry is charged with the important duty of seeing that these conditions are complied with, and for every failure the contractor must abide the consequences.

In order to increase the value of the work, several changes have been made, which may be briefly referred to here. It has been arranged to send out the cotton seed, tobacco seed, sorghum seed, and sugar-beet seed, and the grasses and forage plants under the direct auspices of the officers of the Department and not through a contractor. By following this plan we have been able to adopt a number of innovations which it is believed will add greatly to the value of the work. The cotton seed, for example, will be selected from high-yielding and comparatively new sorts. The Department has been working for several years improving cottons by breeding and selection, and gradually the seed of these new forms will be worked into the distribution. Furthermore, the adaptation of certain varieties to peculiar conditions of soil and climate will be considered, and this, together with the gradual extension of better grades, will, it is believed, do much to improve the cotton industry in the South. Tobacco seed will be handled in very much the same way as the cotton seed, selected seed being used and varieties sent into districts where the conditions of soil and climate are favorable for their highest development.

With the grasses and forage plants the object will be to demonstrate what varieties are of special promise for different regions, and to this end the country will be properly districted and such seed sent into each district as the experience gained through the work of the scientific branches of the Department may suggest.

It has long been my belief that much good might be accomplished by using a part of the appropriation in a judicious dissemination of some of the more valuable trees. Plans have therefore been made to place at the disposal of each Senator, Member, and Delegate in Congress a limited number of selected trees, the object being to encourage a love for tree planting and all that this work involves. It will, of course, be entirely beyond the scope of the Department to send a large number of trees to any one place, but it is believed that the action contemplated will eventually lead to extensive planting through the educational effects of the work. Commercial establishments are well prepared to supply trees in nearly all parts of the country at reasonable cost, and the plan of our work will, it is believed, eventually advance their interests. Already there has been secured for distribution a choice collection of nut trees, principally pecans, and these are

being grown by the Department from nuts gathered from selected trees in all parts of the country.

It is believed that some such plan as outlined for the distribution of the special crops mentioned above can be applied also to the general distribution of vegetable and flower seeds. It will certainly be an advantage to intelligently district the country and send into each district only such seeds as are likely to improve its conditions. This will obviate the necessity of having to secure such immense quantities of single varieties, a task which is often difficult to perform. It will furthermore enable the Department to gradually introduce into the distribution rarer sorts, and to drop these after the first year or two, leaving the demand for them to be supplied by the trade. When the Department has secured the seeds and plants which it is believed are best adapted to certain districts, its responsibility, to a certain extent, ends, as it looks to Senators and Members of Congress to place them in the hands of such of their constituents as in their judgment will make the best use of them. Due notice, however, will always be given of every special distribution, and in addition all information that the Department possesses will be furnished, so that the recipients may act intelligently in handling whatever may be sent out. Carrying out the work as here outlined it is believed will result in good to the entire country, as is the intent of the existing law.

BUREAU OF SOILS.

The Division of Soils was organized in the Weather Bureau in 1894 by Executive order. In 1895 it became an independent division in the Department, with an appropriation of $15,000. In 1899 the functions were enlarged to include the mapping of tobacco soils and other necessary tobacco investigations, with a total appropriation of $26,300. In 1900 the appropriation was increased to $31,300. In the act approved March 2, 1901, the Division was reorganized into a bureau, with an appropriation of $109,140, and in joint resolution No. 8 of the same Congress provision was made for the printing annually of 17,000 copies of the Field Operations of the (then) Division, at an estimated cost of $20,000; 3,000 to be distributed by the Senate, 6,000 by the House, and 8,000 by the Department.

This remarkably rapid evolution of the soil work of the Department from a subordinate division of the Weather Bureau to a bureau organization of its own, within a period of six years from its inception, is based wholly upon the economic importance and value of the work, the careful and conscientious administration of its affairs, and a thorough understanding and appreciation of its aims by the people upon which the liberal support accorded by Congress has been granted.

The Bureau of Soils is charged with the study of soil problems in

their relation to practical agriculture; with the investigation of the physical and chemical properties of soils and of the materials and methods involved in artificial fertilization and its influence upon the original soils; with the classification and mapping of soils in agricultural districts to show the distribution of the various soil types, with a view to determining their adaptability to certain crops, and their management and treatment; with the investigation of alkali problems and their relations to irrigation and seepage waters, the causes of the rise and accumulation of alkali, and the reclamation of injured or abandoned lands; with the investigation of tobacco soils and the methods of cultivation and of curing, with especial reference to fermentation; the introduction, through selection and breeding, of improved varieties into the principal tobacco districts of the United States, and to secure as far as may be possible a change in the methods of supplying tobacco to foreign countries.

The reorganization of this Division into a Bureau of Soils, with a large increase of funds and a corresponding enlargement of the opportunities for work, went into effect on July 1, 1901; but $10,000 had been made immediately available, and the gradual adoption of the plans of reorganization occupied fully six months of the fiscal year for which this report is intended. The reorganization was based upon the following facts:

In my last report I called attention to the great demand for the soil survey and mapping of soil areas throughout the country and the consequent need of a much larger appropriation. At that time the Division of Soils had made detailed maps of 3,386 square miles, or 2,160,000 acres, a part of which had been published, on a scale of 1 inch to the mile. This work had covered portions of Maryland, Connecticut, Pennsylvania, Louisiana, Utah, California, and Arizona. The Maryland work showed a variety of soils in southern Maryland and the Eastern Shore adapted to a number of special lines of agriculture, including truck farming, fruit growing, special types of tobacco, and general farming, and gave a basis for the specializing of crops and agricultural interests and improved methods of treating the soil, which give promise, if carried out, of important developments in that section. The work in Connecticut had pointed out the possibilities of growing the Sumatra tobacco and of building up a very profitable industry in the raising of this fine type of wrapper leaf. The possibility of this has since been shown in the production of a small crop of very desirable wrapper leaf last year and the growing during the present season of about 43 acres of Sumatra tobacco which promises very well, and which indicates to the tobacco men that the $6,000,000 worth of tobacco which we annually import can be as well produced in Florida and in the Connecticut Valley, with large profits to our own growers.

Equally significant results are looked for in the introduction of Havana tobacco into the tobacco districts of Pennsylvania, Ohio, and Texas, and there was a great demand from these States to map the soils and investigate the possibilities of introducing new varieties of tobacco which would bring a higher market price and would tend to diminish the imports of the finer qualities of filler tobacco.

There was a strong demand from the fruit growers for the preparation of maps showing the distribution of the important fruit lands, particularly of the mountain areas in the Atlantic Coast States. The success of the mountain peaches in western Maryland and of the pippin and other varieties of apples in the mountains of Virginia and North Carolina, and the experience that these were successful only on certain types of soil, made it appear that a detailed soil map would be advantageous and would tend to prevent costly experiments on soils which years of experience might show unsuited to the crop.

The important commercial development of the sugar-beet industry and the large investments necessary in the establishment of sugar factories have created considerable interest and wide demand for soil-survey work in order to locate the best sugar-beet soils where climatic and other conditions were supposed to be favorable for the building up of this industry. The director of the Arizona Experiment Station reported that the sugar content in pounds per acre from five characteristic soils of that Territory ranged from 1,491 to 3,361 pounds, the intermediate yields being 1,521, 2,006, and 2,267 pounds, and declared that it was exceedingly desirable to have the soil outlined that gave the largest yields of sugar. Urgent requests on similar lines came from important sugar-beet areas of the southern and central coast regions of California and from those of New York and Michigan, as well as other States. With the training and experience of our field men the soils of these areas can be definitely outlined and their relation to the production and purity of sugar beets determined in advance of any costly investments which might prove unprofitable.

The work of the soil survey in the Western irrigated district and the investigation of the alkali problem, which has been a serious menace in certain localities, and the results of this survey, which show that the problem can be easily and economically controlled by underdrainage and improved cultural methods, have aroused a great deal of interest, and many urgent requests have been made that the work be extended to other areas.

The tobacco investigations are bringing most important results by the introduction of new varieties and better methods of handling the crop, thereby creating new and more important types for this country and improving those already grown. It was found imperatively necessary, in order to obtain the best results, to secure the very best

available experts in this country, and in order to do this much larger salaries had to be given than had formerly been allowed in the divisional organization. The wisdom of this step has been amply demonstrated in the results attained and in the efforts of foreign countries to induce our experts to leave and transfer their valuable work to other localities.

The Agricultural Committees of both Houses of Congress looked into these matters very carefully, and, after a thorough consideration of the questions involved, decided that the reorganization of the Division into a bureau was necessary to enable the Department to handle these lines of work in a manner commensurate with their commercial importance. Accordingly this change was made by Congress, and the appropriation was very largely increased and the organization was made much more efficient than it had been on the old divisional plan. Congress also provided for the immediate use of $10,000 of the funds to allow of the plans being definitely formulated and men trained, so that on the 1st of July, 1901, the Bureau could start as a well-organized office for the efficient working out of the duties pertaining to it. This made it possible to secure the practical reorganization of the Bureau several months in advance of the actual operation of the law, and the wisdom of this has been amply demonstrated in the operations outlined in this report.

This action of Congress has opened up a new and very important era for the investigation of soils, which should be of fundamental value in the development of the agricultural interests of the country.

The following summary of the operations of the Division during the past year will show the economic aspect of the work and will be of interest to all those engaged in practical agriculture, especially those interested in intensive cultivation, and the introduction and management of new crops and industries, and in the remarkable advance recently made in agricultural industries of the country, which is the foundation of much of its commercial prosperity.

PROGRESS AND COST OF THE SOIL SURVEY.

The area surveyed and mapped during the fiscal year was 5,596 square miles, or 3,581,440 acres. The area previously reported as having been surveyed was 3,486 square miles, making a total of 9,082 square miles, or 5,812,480 acres. Field work was carried on during the year in California, Maryland, Michigan, New York, North Carolina, Ohio, Pennsylvania, Utah, Virginia, and Washington; and the preparations were all made for field work to be started in Idaho, New Jersey, Tennessee, and Texas immediately upon the agricultural bill going into effect on the 1st of July, and also for field work in Louisiana, Mississippi, Georgia, and Florida, to be started on the 1st of October, when parties working in the Northern States will be sent South.

The following table gives the area of soils surveyed and mapped in the several States in which the work has been carried on to the end of the fiscal year:

Area surveyed and mapped during fiscal year ending June 30, 1901, and the area previously reported.

State or Territory.	1901.	Previously reported.	Total.	
			Square miles.	Acres.
	Sq. miles.	Sq. miles.		
Arizona		400	400	256,000
California	951	450*	1,401	896,640
Connecticut		245	245	156,800
Idaho	(a)			
Louisiana		1,000	1,000	640,000
Maryland	1,137	625	1,762	1,127,680
Massachusetts		155	155	99,200
Michigan	a 35			
New Jersey	(a)			
New Mexico		100	100	64,000
New York	a 20			
North Carolina	1,700	100	1,800	1,152,000
Ohio	480		480	307,200
Pennsylvania	320	100	420	268,800
Tennessee	(a)			
Texas	(a)			
Utah	457	311	768	491,520
Virginia	250		250	160,000
Washington	301		301	192,640
Total	5,596	3,486	9,082	5,812,480

a Field work in Michigan and New York was started on June 15, but the area surveyed in this fiscal year was too small to report upon the cost of the work and they have not been included in the total. The preparation for the other States marked were all made in the fiscal year ending June 30, 1901, but the field work was actually started from the 1st to the 3d of July.

The total cost of the work in the field amounted to $11,309, of which $1,500 was paid by various State organizations. Including the cost of the work in the field, the preparation of reports, and transportation and supplies, the field work has cost the Department on the average $3.26 per square mile, or about 51 cents per 100 acres. This is exclusive of the cost of publications. That the results have been of value to the communities and to the country at large has been attested in many gratifying ways. Requests for the extension of the work have come from prominent and thoughtful men in nearly all the States and Territories and from those interested in many of the large agricultural interests, such as sugar beet, tobacco, wheat, truck, rice, fruit; and especially from many areas where peculiar conditions of soil, climate, transportation, or labor make it necessary to introduce new crops or new methods for successful competition in the interests of the country.

Our trained soil experts remain from three to nine months in a district, visiting almost every foot of the area and mapping what they

find, studying the methods and conditions, meeting the people and learning of their successes and failures, and thus they can not help acquiring a fund of information relative to the soils, crops, and methods of the districts visited which should be a basis for the introduction of new crops or improved methods. The field men have at all times the cordial support and all the resources of the laboratories of the Bureau of Soils and of the other scientific divisions and bureaus of the Department.

Demands have been made on the Bureau for the extension of the soil survey to Alaska, Porto Rico, Hawaii, and more recently from the War Department for trained men for similar lines of work in the Philippine Islands. The lack of a sufficient number of trained men has prevented an extension of the work to any of these areas heretofore, but these demands should be met in as short a time as possible.

DETAILS OF THE FIELD WORK.

WESTERN DIVISION.

Results in California.—Field work was carried on during almost the entire fiscal year in California. The soil survey of 640 square miles around Fresno, mentioned in my last report, was completed during the first part of the year.

An area of about 300 square miles was surveyed around Santa Ana, extending from the foothills to the Pacific Ocean, the main part being formed by the vast delta plain of the Santa Ana River. In that portion of the region above the 70-foot contour there is little or no alkali, and the lands are well adapted to citrus fruits and nut trees. Below this elevation the lowlands are devoted either to alfalfa or natural pasturage and to important special industries of celery and truck growing. The fruit industry is hardly known in this portion of the area.

Nine different types of soil were recognized, each with distinctive agricultural values and best adapted to different kinds of crops. The soils of the high-lying portions of the area are, as a rule, well drained, and, owing to the small amount of water available for irrigation and the care which has to be exercised in the use of it, very little alkali has been found. The cementing of the canals and ditches to conserve the water gives an object lesson of the practical value of care and economy in the use of water on soils of this character in preventing the rise of alkali, which in the low-lying portion is a serious menace, but which can be controlled by underdrainage.

About 200 square miles were surveyed in the San Gabriel Valley. The problems encountered were purely soil problems, as there was no land injured by alkali or seepage waters, except a few small spots at the narrows where the San Gabriel River leaves the valley. The depth to standing water is great and the difficulties of obtaining water enough to keep the crops alive during the past dry years have been

the cause of much expense, but have undoubtedly saved the country from injury by alkali.

The most important problem which was encountered was the question of fertilizing the soils. California has no fertilizer-control law. Numerous brands of fertilizers are manufactured, each with a special object in view, and all are sold at high prices and with no guaranties but the manufacturers' analyses. The farmers are using large quantities of these fertilizers, in many cases unnecessarily, and in most cases without discretion, but in the hopes of supplying the requirements of the plant and of increasing the yield of fruit. There is great necessity for information on these points, and this information can only be gained through extensive plat experiments. The soil maps will show the best places to carry on this experimental work. Investigations in this line by some one competent to undertake such studies should be started at once, and the excessive application of fertilizers should be stopped, unless the necessity of such large applications is proved by experiment.

About 216 square miles were surveyed around Hanford. The most important problems encountered in this section are those of seepage water and alkali. All of the land is low, most of it being in the slough country, and when well drained and free from alkali is very productive. The drainage is into Tulare Lake and into the San Joaquin River by way of the sloughs which connect the Kings and San Joaquin rivers. During the winter and spring months the sloughs and streams fill with water and soak the subsoil, so that standing water is found at less than 6 feet from the surface of the ground. Everything possible is done to assist this filling of the soil with water, for the success of the following crop is supposed to depend upon the water which is thus stored in the soils. The natural drainage by the sloughs is often artificially blocked by dams during this period, and the irrigation canals continually carry water on the land. There is no question that the crops are benefited by the water stored in this way at certain seasons, but at the same time some of the most valuable land is being ruined by the rise of alkali due to the high water table. Already large areas are left out of cultivation, and unless the present practices are changed further damage will ensue. Instead of damming the drainage systems, everything possible should be done to carry off the winter's excess of water, and, instead of depending upon subirrigation to furnish the needed water supply, the water should be applied from the top of the ground, which would tend to drive the alkali down.

In order thoroughly to reclaim the district and insure against further damage, a drainage district should be formed and outlet canals be dug for the free passage of the excess of water, and the sloughs which are now dammed should be opened. If winter irrigation is to be practiced, it should be from the surface, for subirrigation in such soils,

particularly if the level of the standing water comes to within 4 or 5 feet of the surface, involves serious danger of the rise of alkali. There are large areas of land already alkaline which could be reclaimed at a profit, and it is hoped that these investigations will make this point so clear that the people of the district can be prevailed upon to make the experiment of reclaiming small areas for demonstration.

Results in Utah.—About 310 square miles were surveyed around Ogden. This area is divided into two agricultural districts, a broad delta plain, upon which Ogden is situated, and in which the principal irrigation is carried on, and an upland portion composed of foothills and mountainous land. In addition to these, there is an area of nearly 100 square miles of recent delta, formed by the recession of the Great Salt Lake since the early surveys were made in 1858. This land is now so full of alkali that no cultivated crops are grown upon it. Eight types of soil were recognized and mapped, each having more or less distinct differences and adapted to different agricultural interests.

The irrigation water of the district is exceptionally good and free from alkali. There is more than enough water to irrigate all the lands within the area, provided it were distributed at proper seasons of the year. Unfortunately, however, the larger part of it comes in the early spring, and there is frequently a shortage during the growing season. Plans are being considered for a large storage reservoir to equalize the distribution and to insure against seasons of drought and low water. Many of the canals run over deep, sandy soils, with no protection against seepage, and it is estimated that fully half of the water is lost in this way. This is not only an unnecessary waste of water, but is the cause of a large amount of injury by the subirrigation of large areas in which the ground water is so near the surface as to be harmful to crops. The whole area surveyed contains about 198,400 acres, of which 137,000 acres could be irrigated. There are actually about 40,000 acres under irrigation. In about 83,000 acres there is so little alkali that their use for cultivated crops would be absolutely safe. About 16,000 acres have sufficient alkali to make their cultivation at least dangerous, while there are 99,000 acres containing too much alkali for crops. Good lands in this vicinity are worth $100 an acre, and when set with valuable fruit trees much more than this, so that the importance of this alkali problem here is apparent.

Results in Washington.—A soil survey was made of about 198,000 acres in the Yakima Valley. Frequent mention has been made by agricultural investigators of the alkali in the soils of this valley. The amount of alkali found by our parties was very small when compared with the area which has been irrigated, but the land which is damaged is near Yakima and is the most valuable land in the valley owing to its proximity to town and the ease with which it can be irrigated. Under the Sunnyside Canal, below North Yakima, practically no land has

been damaged yet, but there is alkali in the subsoil which may rise to the surface in low places. Excessive amounts of water for irrigation are constantly being used, and the subsoil is rapidly filling with seepage water. If this rise of subsoil water goes on much longer lands will suffer. Only a small percentage of the available land is irrigated at present, and it is hoped that the dangers of overirrigation may be shown so clearly that land which is now threatened may be saved.

EASTERN DIVISION.

Results in Pennsylvania.—During the fiscal year the survey of Lancaster area, 270 square miles, started during the latter part of the previous year, was completed. Lancaster County was selected for the work, as it is an important tobacco-producing section, that it might serve as a basis for the experiments on the improvement of the Pennsylvania tobacco and the introduction of the Cuban type of filler leaf. The area surveyed consists of a broad limestone valley, with sandstone and shale ridges of sedimentary rock, and, in the southern part, of the Piedmont plateau of crystalline rocks. The difference in the commercial value of the eight types of soil established is very great. The best limestone lands are worth from $125 to $250 an acre, while some of the other soils have merely a nominal value. The investigations, while started in the interests of the tobacco culture, indicate that new industries may be established on soils that at the present time are held in slight esteem. Important lessons are taught from the industry of the people which would be of immense practical value if applied in other localities. Active steps have already been taken to follow up this survey with an attempt to introduce a better type of tobacco on certain soils which closely resemble some of the Cuban soils.

During the spring of 1901 this work was extended into Dauphin and Lebanon counties.

Results in Ohio.—A soil survey was made of Montgomery County, comprising an area of 480 square miles. This county is the center of the Zimmer Spanish cigar-filler tobacco district, and it is intended to follow up the survey with tobacco investigations similar to those planned for Pennsylvania. The eight types of soil found in the county are derived from glacial material, which has been reworked to some extent by stream action.

Results in North Carolina.—The North Carolina department of agriculture asked the cooperation of this Department two years ago in the classification and mapping of the soils of that State, as a basis for experimentation upon the crops and methods of cultivation and fertilization best adapted to the several soils. In pursuance of this cooperation, a soil survey was made from Raleigh to Newbern, a distance of 100 miles, with an average width of about 9 miles, crossing the entire section of the coastal plains and reaching up into the soils of the

crystalline rock areas of the Piedmont Plateau. The area selected was close to the Neuse River, which has considerably altered the materials within a few miles of its channel, making such changes, in fact, that 16 distinct soil types were recognized and their agricultural values determined. It seems almost incredible that in a district so comparatively small as this, and on what has always been considered rather a uniform portion of the coastal plain, there should be so great a variation in the soil types, and that these different soils should have such markedly different values for crops.

The fact remains, however, that the differences are very great, and it was pointed out in the report that certain of the types are adapted to certain interests peculiar to that region or to similar regions of the coastal plains which have been studied elsewhere. The soils adapted to truck crops, bright tobacco, cotton, wheat, corn, and grass, and those which are not adapted to any of our present crops, are indicated on the maps and are described in the report.

In the spring of 1901 an area of 800 square miles was surveyed around Statesville, N. C., and a camp was established there for the training of some of our field men. The soils in this area are derived from granites, gneisses, and other crystalline rocks, and are similar to the soils of the Piedmont region in Virginia and Maryland. The principal crops are cotton, corn, and wheat. It was apparent during the survey that the agricultural possibilities of the two principal soil types have never been realized. There is a wide opportunity for the introduction of improved methods and of new crops and agricultural interests, and the North Carolina department of agriculture has announced that these possibilities will be fully investigated.

Results in Virginia.—The demands for the soil work in Virginia were so great and from such a number of widely different localities in the State that it was difficult to determine where the survey should be started. It was finally decided to take up an area in Bedford County, including a portion of Piedmont Virginia and of the Blue Ridge Mountains, and then to enter Prince Edward County, which is typically a dark-tobacco district. About 600 square miles will be surveyed in Bedford County. On the Piedmont portion of the area the soils are derived from disintegration of crystalline rocks, and the prevailing types are well adapted to grass and corn particularly. Considerable attention is already paid to the raising of cattle, and the heavy shipping and manufacturing tobaccos are produced to some extent. The most important results of the survey, however, are looked for in the classification of the mountain lands in the development of the apple industry. This section is already recognized as a prominent apple-growing district, but there is room for the extension of both the apple and peach industries. Soil types are being recognized and mapped which are adapted to these fruits and to their different

varieties, and it is believed that the work will be of great value to horticulturists.

Results in Maryland.—The cooperation with the Maryland geological survey and Experiment Station, looking to the development of the agricultural industries of the State, has been continued. Soil surveys of St. Mary, Calvert, Kent, and Prince George counties were completed during the fiscal year. In St. Mary and Calvert counties there are eight types of soil, which differ greatly in character and agricultural value. They are suited to different crops and agricultural conditions; but this fact has never been fully realized, and it is only by realization of this and the proper adaptation of the soils to the crops that the greatest development of the country can be brought about. There are soils there ranging in value from $3 to $10 an acre which are in every way equal to the soils in other localities worth ten times as much, and which are profitably worked at this valuation. In Prince George County a greater number of soil types was encountered and a greater variety of interests can be subserved. The proximity to the Washington and Baltimore markets should make it possible to introduce intensive methods, which would greatly change the agricultural conditions of the region. It is understood that the Maryland Experiment Station will actively push the further investigation of the possibilities of developments in the crop interests and of new methods adapted to different soils.

DRAINAGE INVESTIGATIONS.

Attention has frequently been called in the reports of the Division of Soils to the possibility and feasibility of reclaiming alkali lands and preventing the deterioration of lands from alkali by efficient underdrainage. This has been dwelt upon by other writers and presented in the strongest possible terms as the most rational and only safe method of solving the alkali problem. Unfortunately, on account of the conservatism of growers, these recommendations have received little or no attention, and there is no general recognition of the possibilities of controlling the problem in this way. Owners who are not at present troubled with alkali do not appreciate the necessity of protecting themselves, and it is a curious fact that just before the alkali becomes so strong as to prevent profitable cultivation the crop yields are the largest. After that the land deteriorates so rapidly that the owner is disheartened and is not inclined to invest money where ordinary means of cultivation have failed to secure profitable returns. It was necessary to make a practical demonstration of the possibilities of growing Sumatra tobacco in Connecticut to get the industry started. The recommendations of the Department in this regard were unheeded until the correctness of its predictions was thus demonstrated.

Attention has heretofore been called to the possibility of reclaiming

the alkali soils of the Yellowstone Valley and to the desirability of reclaiming the great alkali flat in the Salt Lake Valley, covering upward of 60,000 acres of redeemable land. It will be necessary, in order to secure the greatest benefit from the soil investigations, to make an actual demonstration of the practicability and efficiency of underdrainage in the reclamation of these alkali tracts.

In 1864 the Government of India published correspondence relating to the deterioration of lands from the presence of alkali, in which the following statements were made:

> In the districts reported there were 59 villages in which the agricultural industries had been wholly or in large part destroyed by the rise of alkali. By the year 1850 it had made great progress and was becoming alarming. From that time until 1858 it increased yearly with frightful rapidity. The cause was attributed to the rising of the springs throughout the tract to within a very short distance of the surface of the soil. First of all is the development of the alkali; second, condition of dried swamp; third, inundation. Water in these valleys used to be about 40 haths (60 feet) below the surface, and in 1858 it was 2 or 3 feet. No temporary improvement can arrest the natural course of things, and notwithstanding accidental checks the work of deterioration, if left to itself, will gradually complete itself, the completion depending upon the amount of land the amount of water can affect. Attention is called to proper construction of canals and irrigating ditches, so as to prevent loss from seepage, and the necessity of economy in the use of water. With such precautions taken, underdrainage would be a sure means of reclaiming the lands from alkali and seepage waters. There is no economical substance practicable within the means of cultivators of any section capable of remedying the saline matters, but wherever drainage can be accomplished the thorough working of the surface soil, with abundance of water from the canal, will, if continued for a couple of seasons, dissolve and carry away the noxious salts, but the drainage must be efficient and rapid, otherwise the salt will merely dissolve and be again deposited in the same place. Drainage will prevent as well as cure, and even a small decimal percentage will surely and in no very long time accumulate to 3 or 4 per cent or more, according to the circumstances of the ground in relation to evaporation and drainage. Wherever alkali comes from, drainage is the only and efficient cure.

With these plain warnings from the reports of English engineers to the Government of India, it would seem that the people and the Government itself had been sufficiently well informed of the gravity of the situation and of the means for the removal of these causes. Yet in reports published by the Government of India in 1870, and even as late as 1881, it is stated that underdrainage had not been attempted, that the recommendations of the engineer officers ten or twenty years before had not been carried out, and that the alkali question was becoming more and more serious and alarming, while the Government was being called upon to support large numbers of people who had been rendered destitute by the encroachments of this evil.

In view of such marked examples as this of the ultraconservatism of agricultural communities, and the fact that the recommendations made by this Department are little heeded, I am becoming more and more convinced that, in order to carry the lessons of the soil survey home to

the individual, it will be necessary for the Department to undertake a practical demonstration of the efficiency of drainage in the reclamation of alkali lands.

Plans were made for such a demonstration during the latter part of the fiscal year, with the cooperation of the Utah Experiment Station and some of the public-spirited people of that State. It was proposed to underdrain a small tract of 10 or 20 acres and cultivate the land in a proper way for two or three years to note the improvements in condition until agricultural crops could be safely grown. The expense of underdrainage when undertaken on a considerable scale should not exceed $15 or $20 per acre, so that the cost of a demonstration of this kind would not be great. Unfortunately the plans were interfered with and the work has had to be temporarily abandoned. It should, however, be taken up at the earliest practicable time.

A great interest has been taken in this line of investigation in Montana, Utah, Arizona, and California, the places where the soil survey has been carried on. A great deal of interest has been expressed in this enterprise, particularly in the Yellowstone Valley, at Salt Lake City, and at Fresno, and plans are now under consideration for a demonstration of this kind at these places.

The actual field expenses of such an experiment would hardly amount to more than the cost of publication of a bulletin containing recommendations which would receive but little notice. The demonstration itself, however, if definitely carried out, would be of infinitely more value, as it would be an object lesson for the people and could not fail to arouse an interest which would spread throughout the community. While the Department is spending thousands of dollars for the investigation of these problems, the matter of expense of such demonstrations should not be considered, provided, as in this case, it seems necessary to use this means to inaugurate better methods, which will be of immense benefit to the localities.

SOIL CLIMATOLOGY.

The Division of Soils was originally organized in the Weather Bureau, under a clause "to investigate the relation of soils to climate and organic life." When for administrative purposes it was reorganized as an independent division of the Department, this work was still recognized as of paramount importance and is still authorized under the first clause of the annual appropriation bill. It was pointed out that the soil, being the receptacle of the rainfall and maintaining the only immediate water supply for crops, is a factor of climatology, and as different types of soil maintain different quantities of water, it may be assumed for all practical purposes that crops growing on these different types of soil, even with the same rainfall and temperature, are really under different climatic conditions. This is the basis of much

of the specialization of agriculture and a principal cause of the local importance of certain districts for special crops, such as truck, tobacco, and fruit, as well as for the distribution of such farm crops as corn, wheat, and grass. The recognition of this fact is largely the basis of the soil survey and for the highest prosperity of agricultural communities. Furthermore, it is a well-known fact that the degree and character of cultivation has a marked effect upon the moisture supply of the soil, and thus controls in no little degree the climatic conditions under which the crop is grown.

In certain sections of the country and on certain soils, notably in California and the Northwestern States, the condition of the soil for various crops and the probable yield can be fairly estimated from the water supply in the soil some weeks, or even months, before the harvest.

In former reports attention was called to the progress made in the perfection of instruments for recording the moisture contents of soils in the field and for determining the tendency to evaporation or loss of water from plants for which an adequate moisture supply must be maintained. Stations were established in different parts of the country and on important soil types for these moisture records. From these records it was possible to show the normal variations which could occur in any soil between the conditions of excessive wet and drought, and the possibilities were pointed out of determining a numerical relation between the soil moisture and the sunshine, temperature, humidity, and wind velocity which would enable the climatic condition to be expressed by some figure representing the relative condition of plant growth at any place in terms of the most favorable conditions. This is in no way covered by the work of the Weather Bureau, which is concerned largely with dynamic meteorology, or the laws and prediction of storms, and will involve an entirely different equipment and an independent set of observations, taken in the fields and soils of growing crops rather than in cities and towns.

The value of such observations, taken by a corps of experts trained to observe and understand plants as florists understand greenhouse plants, can not be estimated. Reports based upon such observations in a period of drought, such as the Middle West has just experienced, would show the actual conditions existing far more accurately than is now possible. Furthermore, as the drought limit is approached in any soil suggestions can be made for preventive measures in cultivation or cropping which may save many bushels of grain on any farm, which in the aggregate for all the farmers who would heed the warnings sent out from Washington would save an immense sum of money to the agriculturists.

The time has come when this work should be again taken up on a

scale commensurate with the extension of at least two or three crop interests. It is certain that the immediate benefit to the farmers will amply repay the expenditure.

SOIL TECHNOLOGY.

The field parties see many opportunities of improvement in the crops or methods of cultivation in the districts in which they are located which they have not time, in the rapid progress of their work, to demonstrate, and for which they must rely upon recommendations in their rather brief reports. Such recommendations seldom accomplish the object sought, on account of the well-known conservatism of growers. It may be that the evidence indicates the need of drainage or the correcting of acidity in the soil, or may suggest the introduction of new and profitable crops. Such suggestions are rarely acted upon in that thorough manner necessary for a practical demonstration, and it therefore seems advisable, if the full value of the soil survey is to be realized, to organize a division of soil technology to work out the suggestions and demonstrate the efficiency of new methods or the feasibility of introducing new crops, as has been done so successfully in the case of the tobacco work.

It is difficult to find trained men for this work in this country, and the success of such an organization would depend largely upon the personnel of the force. Our agricultural colleges should turn out such men, but they seem not to have done so. There are practical men who could carry on such work under the direction of our scientists, but they are usually so successful as managers of estates that they can not be induced to accept a place for the salaries allowed by Congress in this Department. It is necessary, in this as in other lines, to train the men ourselves, unless higher salaries are paid.

TOBACCO INVESTIGATIONS.

In my last report attention was called to the success of the exhibit of American-grown leaf tobacco at the Paris Exposition and the number of awards given. After the installation of the exhibit and the work of the jury of awards had been completed the tobacco expert of the Division spent some time, under orders from the Secretary, visiting the foreign markets, particularly in Paris, Bremen, Amsterdam, and London, where large quantities of our domestic tobaccos are sold or where we ourselves purchase leaf for our own use. The information gathered in this way of the character of the tobacco from all over the world with which we have to compete in our foreign trade, of the requirements of these markets, and of the methods of selling under the regie system prevailing in certain of the European countries,

promises to be of great value in the investigations which it is planned soon to take up of the export types from Virginia, North Carolina, Kentucky, and Tennessee.

Upon the return to this country of our tobacco expert, Mr. Floyd, active steps were taken to start some investigations on the improvement of the Pennsylvania leaf, with the object of seeing what could be done with it, and the further object of introducing a more desirable filler leaf, if such a step seemed necessary for the building up of the trade in Pennsylvania tobacco. A soil survey had been made of the principal tobacco districts of Lancaster County as a basis for the possible introduction of new varieties. In the preliminary work of manipulating the present type of leaf grown in Lancaster County a different method of fermentation was tried, in which the tobacco is fermented in bulk, according to the practice in Cuba and Florida, which had been successfully used on the Connecticut leaf the year before.

Fermentation by this process is completed within forty or fifty days, under the constant supervision of an attendant, who turns the bulk from time to time, thus making it possible to watch the progress of the fermentation and to modify the conditions if circumstances seem to require it. This is a decided gain in point of time, and is much less expensive in the way of storage and insurance risks than the old method of case fermentation, where the tobacco was set aside for from six to nine months in a tightly packed case, in which it was doubtful whether it would escape injury by black rot.

The first experiment was made on an old crop which had not fermented by the usual case method, but which had developed a considerable amount of black rot. Bulk fermentation proved perfectly successful, the quality of the leaf being greatly improved and no further development of the black rot appearing while the tobacco was in bulk or afterwards. The results of this experiment seemed to be of such marked value that several of the leading packers of Lancaster opened their warehouses to us and installed, at considerable expense, proper facilities for handling the crop. As a result of this, during the winter and spring of 1901 over 4,000,000 pounds of tobacco were fermented in bulk under our direction, with a total loss of only 35 pounds from black rot and all other damage. This is exclusive of one of the first bulks, which was almost entirely destroyed by black rot, as the conditions for handling the crop were not thoroughly understood. It is a difficult matter to give any close estimate of the usual damage from black rot, as the dealers hesitate very often before admitting that there is any at all; but a conservative estimate would show a loss of $500,000 or more per year in the Pennsylvania crop, and in some years it must considerably exceed this figure. The success of this method of fermenting the tobacco, both in improving the quality of the leaf, which is generally conceded, and in controlling the dreaded

black rot, about which there is no longer any doubt, is assured, and it is confidently predicted by the packers themselves that the new method will entirely supersede the old, especially where large crops are to be handled. If this is done it will mean a saving to the State of Pennsylvania alone of an amount far exceeding the present cost of the whole Soils Division.

In the early spring arrangements were made with four prominent growers on different soil types in Lancaster County to introduce some of the finer Cuban seed, and these experiments are now progressing under our control, the latest reports of the work being very promising. It will, of course, be several months before the actual results can be determined, but if they seem to warrant it all necessary attention will be given to the important experiments at this point in the endeavor to raise the quality of the Pennsylvania leaf.

In my last report I announced the complete success of the small experiment of growing a fine type of Sumatra leaf on certain soils in the Connecticut Valley. This experiment had been made on a small tract of one-third of an acre, and it was thought best to extend it to a larger area in order to see if, under the conditions prevailing and with the large cost of production, the tobacco could be profitably raised in the valley. Accordingly, in the spring of 1901 arrangements were made with a number of farmers in Connecticut and Massachusetts, in areas as widely separated as possible, and on typical soils which it was thought could be used for the Sumatra tobacco, and nearly 43 acres were placed under our immediate control. It was agreed that the farmers should furnish all needful material and labor, and that the Department should assume direction of affairs in the practical management of the crop.

The understanding is that all the necessary information regarding the actual cost of the work shall be at the disposal of the Department to publish, and that the Department itself shall have the right to sell the crop for the farmers, so as to insure an absolutely impartial judgment from the leaf dealers as to the quality and value of the product. It will, of course, be some time before the actual results of this large experiment will be available for publication. It has been estimated roughly that about $20,000 has been invested on the part of the farmers, with no expense whatever to the Department except that of supervision.

The experiment has attracted a most remarkable interest, and prominent growers and packers have visited Tariffville, the Department's headquarters for this work, from many places in Connecticut and Massachusetts, as well as from Pennsylvania, New York, Ohio, Wisconsin, and Florida. The present indications are that the crop will yield at least double the cost of production, although nearly three-fourths of the original cost is in what might be termed permanent improvements—that is, in the erection of the shade—which will last from

five to ten years. It is probable that within two or three months from the time of the publication of this report the data will be available for the issuing of a special report on this experiment, giving the methods and cost of production and the value of the crop. It would therefore be unwise at this time to attempt to forecast the results.

In view of the phenomenal success of the introduction of Sumatra leaf into the Connecticut Valley and the control of black rot in the Pennsylvania crop, there have been many urgent demands for help in the tobacco industry in New York, Ohio, Wisconsin, Texas, and Florida. Preliminary steps have been taken to meet these demands, but they are so great that it will take considerable time to extend help even where it is most needed. Active measures are being taken, as announced in my last report, for investigating the possibilities of growing Havana tobacco in Texas, and it is aimed to make this experiment one of the strong features of our work for the coming year.

It must not be overlooked that there is pressing need of investigations in the manufacturing and export types of the Southern States, and there have been many requests for such help on the part of the Department. It has seemed wise, however, to confine our attention to the highly organized industry in the production and handling of the cigar types and to get this work well established before the other types are taken up. Just as soon as possible, however, the Virginia, North Carolina, Tennessee, and Kentucky districts will be attended to. Preliminary work is being done in several of the States in the construction of soil maps of the important tobacco areas, and plans are being perfected for the improvement of the types and grades of leaf grown there.

During the spring of 1901 a comprehensive exhibit of leaf tobacco was installed at the Pan-American Exposition in Buffalo, modeled somewhat after the exhibit at Paris, although necessarily much smaller, as the space at our command was considerably less.

Another important line which has been taken up is the securing of tobacco seed for Congressional distribution. Contracts have been made with leading growers in the various States to have seeds saved from healthy, vigorous, well-bred plants, and arrangements have been perfected for the distribution of these varieties to the districts to which they are particularly adapted. It is believed that this will be a great improvement over the former miscellaneous distribution of tobaccos of all kinds to all districts.

EXPENSES OF THE WORK.

In thus briefly reviewing the work of the Division of Soils and stating the results, the commercial value of which is already apparent in several lines, and which open up great possibilities for improving methods and crops in still others, I can not refrain from showing the

very moderate expense this work has been to the Department and to the country during the past fiscal year, as follows:

		Per cent.
Administrative expenses	$10,081.68	25.3
Laboratories	5,929.45	14.9
Tobacco investigations	5,609.64	14
Eastern soil survey	8,828.88	22.2
Western soil survey	9,392.45	23.6
	39,842.10	100

It is only necessary to compare the extent of the operations of the Division, the results accomplished during the year, and the present well-organized condition of the work with the total outlay involved to show conclusively that the money appropriated has been wisely and economically expended and that the results could only have been secured by an excellent organization and by efficient and earnest cooperation on the part of all employees of the Division.

REVIEW OF SOIL WORK.

This report marks an epoch in the work of the Division of Soils, namely, the transformation of the Division into a bureau well organized and well equipped to carry on the work in a larger and broader field than has ever before been possible. In this connection certain features characterizing the work of the Division during the past year invite special attention.

Every impartial reader of this report will concede to me the right to point to the work of the Division of Soils as work which fully and thoroughly meets the supreme test of the Department's practical utility, namely, the material benefits accruing to the tillers of the soil with a very modest expenditure of public funds.

The popularity of the work of the soil survey, as shown in the numerous requests for its extension which have come from all the States and Territories, has been amply justified by the practical results already attained by our field parties. The prophecy volunteered not so long ago of the impracticability of a comprehensive and effective soil survey has been effectually disproved. To-day there is not only no difficulty in securing active cooperation with State organizations, but cooperation has been offered far in excess of our present available force. The workers in our field parties are every season acquiring new and valuable experience, which promises to make them more useful in the future. The success of their work is attracting trained men, who look to this as one of the most promising fields for research work in economic lines. The lack of trained men previously commented on has been met by thorough and conscientious training on our part of promising young men in our laboratory and field methods, so that we are practically independent in this respect and can meet any reasonable

demands which may be made for the extension of the work within the limits of the appropriation by Congress.

In our laboratories the problems of soil physics and soil chemistry are being intelligently studied and in certain lines effectually solved, but it is perhaps in our tobacco experiments that we have achieved the most striking results, measured by the immediate effects upon the cultivator and by the appreciation of the public. These experiments are based upon the soil survey, and they justify by their results the confident statement, as anyone who carefully reads this report can see, that what has already been done, to say nothing of what we hope to do in the future, has laid the foundation of added wealth to tobacco growers in this country aggregating yearly far more than the entire cost of the Division of Soils since its establishment.

With such results as have been already achieved we can certainly look forward with the utmost confidence to the results to be obtained by the Bureau of Soils with the larger appropriation and additional equipment which have been, and which may be, provided by the far-sighted liberality of Congress.

BUREAU OF CHEMISTRY.

Chemistry is a science which touches every branch of agriculture. In the organic act establishing the Department of Agriculture, among the scientific advisers whom the Commissioner of Agriculture was authorized to appoint, a chemist was first mentioned. The Bureau of Chemistry is the natural outgrowth of the Division of Chemistry, which was the first scientific office established at the time of the organization of the Department in 1862. The work of this branch of the scientific service has gradually extended until it has reached its present proportions. Gradually the chemical work of the Department of Agriculture has come to be regarded as the most important of all the chemical work for the Government. The scope of the work at the present time, together with the relations which have been established by it with other Departments of the Government, can best be illustrated by a brief statement of the nature of the investigations which have been conducted during the fiscal year ended June 30, 1901. During that period there were received for examination or analysis in the Division of Chemistry 3,824 samples of all kinds.

INVESTIGATIONS OF THE COMPOSITION, NUTRITIVE VALUE, AND ADULTERATION OF FOOD PRODUCTS.

The subjects of investigation have been, first, the study of the composition, nutritive value, and adulteration of food products. The work of the year has been devoted particularly to the study of preserved meats, with a view of comparing the preserved article with the

original, in respect of its composition and nutritive value, and to determine the preservatives, if any, which are employed in the process. This is a part of the elaborate work which has been carried on for many years in this line and which is recognized throughout the world as the most important contribution to this branch of agricultural science which has ever been made. The bulletins relating to the subject of the adulteration of foods, although printed in more than the usual numbers, have been entirely taken up by the demands from scientific men throughout the world, so that none remain now for distribution. The importance of this work has been recognized in a very practical way by the publication of a volume, by high chemical authorities, on food adulteration, in which it is stated that the contents of the work consist chiefly of the investigations of the Division of Chemistry and that the justification of its publication lies in the fact that the bulletins containing these investigations are no longer available for use.

The importance of securing pure food is of equal value both to the farmer and the consumer, and the efforts of the Division of Chemistry have been for many years and still are devoted to this great purpose.

EXAMINATION OF IMPORTED FOOD PRODUCTS.

In connection with this work, by special authority of Congress, the Division of Chemistry has examined food products imported into this country which are suspected of adulteration or of containing injurious constituents. While Congress has not authorized the Department of Agriculture in any way to protect the people of this country from frauds in food adulteration, it has conferred the authority upon the Department of protecting the health of our people from injurious substances imported in foods. The investigations during the past year have been devoted particularly to olive oils, preserved meats, and wines. The greater part of these investigations is considered of a confidential nature, and the results have not been published up to this time. It is believed, however, that the time will soon come when the results of these investigations can with profit be given to the public.

EXAMINATION OF FOODS INTENDED FOR EXPORT.

With a similar purpose in view, the Congress of the United States has authorized the Secretary of Agriculture, through the Bureau of Chemistry, to inspect American food products intended for export to foreign countries where chemical and physical tests are applied to the sale of foods. Unfortunately Congress did not give a sufficient appropriation to the Bureau of Chemistry to permit the execution of this law in a proper way. It is important that our food products going abroad be pure and wholesome, and that we protect our exporters

against any unjust discrimination in foreign countries. To this end an inspection, such as Congress provided for, is absolutely necessary. During the past year this inspection was devoted particularly to exported dairy products and wines, but it is hoped that Congress will provide for the extension of this work to all food products of every description.

INVESTIGATIONS IN CONNECTION WITH ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS.

The Division of Chemistry has continued during the year to study methods of analysis and investigation of soils, fertilizers, fodders and other feeding stuffs, tannins, sugars, and dairy products, in connection with the Association of Official Agricultural Chemists of the United States. This work, in which the Division of Chemistry has taken a leading part during the past sixteen years, has placed the agricultural chemists of this country on a plane which, for unity of action and purpose and the value of the results obtained, has enabled them to secure a higher position of authority and achievement than any of the other agricultural chemists of the world. There is, in other words, no organized body of agricultural chemists to-day which compares in efficiency and thoroughness of work with our own, and this has been due largely to the work of the Division of Chemistry, in collaboration with the agricultural chemists of our colleges and experiment stations.

WORK OF FOREST CHEMISTRY.

The work of forest chemistry in the Bureau of Chemistry is of the utmost practical importance to the investigations of forestry. This work is devoted to the study of forest products in regard to their composition, their relation to the soil, and the products which they can yield. When it is considered that many of the great technical chemical industries of the country are intimately dependent on forest products, the magnitude of this work is easily understood. Among these great interests the tanning industry stands, perhaps, first, followed closely by the industries devoted to the manufacture of wood pulp and to the distillation of wood and the production of wood spirit, methyl alcohol, acetone, pyroligneous acid, charcoal, and other products. This work is now thoroughly organized in the Bureau and will be prosecuted with still greater vigor.

WORK OF DAIRY CHEMISTRY.

The laboratory of dairy chemistry in the Bureau has been more fully equipped and organized and is devoted especially to a study of the best methods of detecting adulterated or preserved dairy products and of preventing unjust discrimination against these products in foreign countries by the application of crude or imperfect methods of analysis or in the exercise of discrimination in any way prejudicial to our interests.

STUDY OF SUGAR-PRODUCING PLANTS.

The sugar laboratory of the Bureau of Chemistry continues to study all the chemical problems relating to the production of sugar-producing plants and the manufacture of sugar therefrom. The chief part of the work is devoted to the study of sugar beets and especially to the influence of environment upon the sugar content thereof. This study is pursued systematically, in collaboration with the agricultural experiment stations, and has already revealed in a definite way the influence of the chief factors of environment, viz, temperature, sunshine, and soil, upon the sugar content of the beet.

Great interest has also lately been awakened in Georgia and Florida looking to the extension of the culture of sugar cane in those localities, and the Bureau of Chemistry has taken up a systematic examination of the soils on which the cane is grown and an analysis of the canes produced.

STUDY OF ROAD-BUILDING MATERIALS.

The laboratory for the study of road materials, established to cooperate with the Office of Public Road Inquiries, has been fully organized and is now one of the important sections of the work of the Bureau. The physical and chemical study of the materials used in building roads will lead to not only greater economy in road construction, but far greater durability. The cementation value of the materials used for surfacing a road differs so widely that the efficiency of the road depends upon the nature of this material. The investigations of this laboratory will show to road builders the exact character of the materials which it is proposed to use for surfacing and lead them to choose those which will give the highest efficiency.

The laboratory has in no way been advertised, except in the exhibit made at the Pan-American Exposition, owing to the limited facilities for carrying on the work; but even with this necessary precaution it has been impossible to keep pace with the heavy demand for tests. Samples have been received from all parts of the United States and even from our foreign possessions.

At the present time the laboratory has the equipment and facilities for testing all varieties of macadam rock, gravels, and clays, and in a short time the equipment for testing paving brick will be ready. In the testing of paving brick, not only will the physical properties of the manufactured brick be determined, but a thorough study will be made of the methods and materials used in making the various types of brick to aid the manufacturer as much as possible in improving his products. The prime object of this laboratory is to aid road builders in selecting the best available materials for their roads.

When it is considered that the cost of properly constructed macadam roads is from $3,000 to $10,000 a mile, and that the cost of paved

roads is generally much greater, it can be seen that selecting the proper material is a very important matter.

CHEMICAL WORK FOR OTHER EXECUTIVE DEPARTMENTS.

The work which the Bureau of Chemistry does for the other Departments of the Government is already great and is constantly increasing in magnitude. By arrangement with the Secretary of the Treasury, the chief of the Bureau of Chemistry has been designated as supervisor of sugar tests in the laboratories of the appraisers at the ports of New York, Philadelphia, and Boston. The control of this branch of the chemical work of the Treasury is of the utmost significance, as sugar furnishes a larger revenue than any other one item imported into the United States. Many suits have been brought against the United States on the alleged grounds of collecting a higher duty than the law contemplates on imported sugar, and this fact led the Secretary of the Treasury to solicit the cooperation of this Department in securing the highest possible accuracy in the scientific ascertainment of the amount of duty to be levied.

For the War Department the Bureau of Chemistry has continued to examine many of the articles of food, clothing, and other supplies for the Army, and this work is continually increasing in magnitude.

For the Post-Office Department the Bureau of Chemistry continues to examine all articles which are supposed to be unmailable under the law or fraudulent in nature.

For the State and other Departments the stationery and inks which are used in producing records are examined in the Bureau of Chemistry.

For the Department of the Interior the Bureau of Chemistry has undertaken a thorough examination of the hot springs in the reservation at Hot Springs, Ark.

Many other miscellaneous items are submitted by the various Departments of the Government for investigation in the Bureau.

It is thus seen that not only is the Bureau of Chemistry charged with chemical investigations of all kinds which relate to agriculture, but also has gradually extended its investigations to the necessities of other Departments. It has thus gradually grown to be recognized as the leading chemical laboratory of the Government, to which all of the Departments have recourse in cases of need for chemical work. It is hoped that Congress will provide for this expanded work of the Bureau of Chemistry, since chemical work can be more economically and efficiently done under a common supervision rather than by the establishment of separate laboratories for every character of investigation.

BUREAU OF FORESTRY.

The work of this Bureau includes the making and execution of working plans for Federal, State, and private forest lands; the study of forests, forest fires, forest grazing, commercial trees, lumbering, and

forest products; the study of economic tree planting and the preparation of planting plans. The Bureau is cooperating with the Federal Government, with several States, and with many private owners in handling their forest lands. Its assistance has been asked for a total area of 52,170,036 acres, of which about 4,000,000 acres are held by lumber companies and other private owners. In its studies of commercial trees and forests, and of their forest problems, it is pursuing lines of investigation indispensable to the development and perpetuation of our national forest resources. Its work of tree planting on the treeless plains already involves the making of planting plans for many thousands of acres of wood lots, shelter belts, and commercial plantations.

On the 1st of July of the present year the Division of Forestry became a Bureau. The change was incidental to the partial reorganization of the Department of Agriculture by Congress at its last session, but it was brought about by the increased understanding of the need of forestry among our people, and especially by the appreciation in Congress of the practical methods used by this Department in its forest work. The change from a Division to a Bureau opens a way for larger organization and more extended work which the public and private demands for assistance in practical forestry have made imperative. The work of the Bureau of Forestry is now conducted along three principal lines: First, forest management, which involves the preparation and execution of working plans for Federal, State, and private forest lands; second, forest investigation, which includes the study of commercial trees, of economic tree planting, of forest fires, grazing, lumbering, forest products, and other important lines of research; and third, the making and maintenance of records, which covers the routine work of the Bureau and the care of its library, laboratory, and photographic collection.

I am glad to report that the Bureau, under its present organization, can meet much more effectively the demands made upon it than was possible as a division. During the fiscal year these demands have not only increased along lines already established, but the growing tendency to refer all important forest matters to the Bureau has been more marked than at any time in the past.

The demands for the assistance and advice of the Bureau are insistent and widespread, and its sphere of usefulness has extended widely with the sound and steady development of the forest movement. With the added effectiveness of its present organization, the adequate extension of its field force, now first made possible by the training of men in our forest schools, and the urgently growing need of its services, the Bureau of Forestry has before it a future rich in possibilities for useful work if its resources do not fall too far behind its actual needs. I have not hesitated to recommend a considerably increased appropriation for the Bureau of Forestry for the coming fiscal year.

because of the vast interests which depend on forest preservation and wise use. In a very real sense an appropriation for these purposes protects and promotes the interests, among others, of all that vast body of our citizens to whom the success of irrigation, mining, grazing, transportation, or the timber trade are of primary importance.

The rapid progress of interest in forestry throughout the South is most gratifying. A very considerable proportion of the most important recent work of the Bureau of Forestry lies in the Southern States.

With the view to encouraging the substitution of conservative for destructive methods, the Bureau has undertaken the preparation of working plans, giving full directions for the management of forest tracts, and will also afford practical assistance on the ground, without cost to the owners of wood lots. In the case of large tracts, however, the cost of traveling expenses and subsistence, together with the necessary helpers of the agents of the Bureau while in the field, must be borne by the owner.

FOREST MANAGEMENT.

The requests upon the Bureau of Forestry from private owners for practical assistance and advice in the handling of their forest lands continue steadily to increase. Of the recent requests for assistance the most noteworthy is the joint application of the Kirby Lumber Company and the Houston Oil Company for help in devising the best method of managing 1,000,000 acres of long-leaf pine land in Texas. This area includes considerably more than half of the long-leaf pine lands in that State.

Personal examinations in the woods were made during the year of 788,890 acres of private ownership, and four detailed working plans were prepared, covering an area of 226,000 acres. One of these was for the tract of a lumber company in Arkansas and another for a tract in Missouri owned by the Deering Harvester Company. The preparation of working plans was begun upon five timber tracts of private ownership, with a total area of 628,000 acres. The largest of these consists of 300,000 acres in Maine, owned by the Great Northern Paper Company. The fact that the offer of cooperation under which these working plans are made is being taken advantage of so extensively by lumber companies and other business organizations indicates clearly the real practical value of the Bureau of Forestry to private owners.

The preparation of working plans for the Federal forest reserves goes steadily on. The working plan for the Black Hills Forest Reserve has been completed, and working plans have been begun for the Prescott, the Bighorn, and the Priest River forest reserves. The immense labor involved in some of these plans is indicated by the fact that for the Black Hills plan alone the diameter of every tree, large or small, was measured on 10,234 acres, and complete ring countings were made

for 4,500 trees. All these field measurements require painstaking elaboration in the office.

In cooperation with the State of New York, which appropriated $3,500 for that purpose, the field work necessary to a working plan for townships 5, 6, and 41, Hamilton County, in the Adirondack Forest Preserve, has been completed. The results of similar cooperation on township 40 have already been printed in the form of a complete working plan.

FOREST INVESTIGATION.

Studies of commercial trees, the practical advantages of which are becoming more and more evident, were continued during the year and extended to many species hitherto not investigated. Extensive studies of the redwood, red fir, and hemlock of the Pacific coast have been completed and are ready for publication. Other trees under investigation are the Western yellow pine, the loblolly and short-leaf pines, the more important Southern hard woods, the Adirondack balsam, and the second-growth hard woods of New England. The location, size, and ownership of the Big Tree groves in the California sierras have been thoroughly studied for the first time, and much fresh information has been obtained of the character of the tree.

The region containing the proposed Appalachian Forest Reserve was examined in cooperation with the United States Geological Survey. The forest on 9,600,000 acres was mapped, the lands were classified, and a careful study was made of the forests. The result of this examination will be embodied in a report dealing with the suitability of this region for the purpose of a national forest reserve, the cost of such a reserve to the Government, and the good which would result from its careful and conservative management.

The creation of the proposed reserve is, in my judgment, urgent, in order to protect the headwaters of important streams, to maintain an already greatly impaired supply of timber, and to provide a national recreation ground which, with the single exception of the Adirondacks, will be readily accessible to a larger number of people than any other forest region in the United States. I believe that these considerations render the purchase by the Federal Government of the proposed reserve in the Southern Appalachians desirable in every way. The policy involved is not new. The proposed purchase will not involve the creation of a precedent, for that has already been done. In 1896 the Government purchased from the Blackfeet Indians of Montana an area of approximately 615,500 acres for the sum of $1,500,000, and on February 22, 1897, it became a part of the Flathead Forest Reserve.

A study of the Sierra Forest Reserve has been undertaken, also in cooperation with the United States Geological Survey, and will shortly be completed.

Following the request of the Secretary of the Interior for reports on technical forest matters, the effect of grazing and of forest fires was investigated in twelve of the forest reserves. A study of the present forest condition of Nebraska and of the causes which led up to it was begun and pushed far toward completion.

The Bureau is now conducting an investigation in the South to devise conservative and practicable methods for improved turpentine orcharding. Since the maintenance of the naval-stores industry is of urgent necessity in the Southern States, this investigation is one of the most important now being carried on by the Bureau.

FOREST EXHIBITS.

The forest exhibit of this Department at the Pan-American Exposition was superior in size and quality to that at the Paris exhibition, which was awarded a gold medal. It included the largest colored transparencies ever made.

TREE PLANTING.

One of the most important and promising lines of work of the Bureau of Forestry is its study of economic tree planting and its cooperation with farmers and others in making forest plantations. Tree planting has so vital and intimate a relation to the welfare of the farmer in the treeless regions that whatever assists him to grow trees assists him also in the production of every other crop. Forty-six thousand one hundred and forty-five acres were examined for planting during the year, and planting plans were prepared for 5,785 acres, while 148 applications for tree-planting plans have been received. The number of applications for commercial plantations of large size is increasing so rapidly that the usefulness of the practical assistance and advice offered to the tree planters will be limited only by the men and money available for the work.

A series of important measurements of the growth of planted groves in the treeless plains has been begun in order to show the value of plantations as business investments. A careful study has been pushed during the year of the encroachment of forests on the Western plains in order to determine the possibility of reclaiming portions of non-agricultural Government land by planting forests.

OFFICE OF EXPERIMENT STATIONS.

PROGRESS OF THE STATIONS.

During the past year the Office of Experiment Stations has made a broad inquiry to determine how far the operations of the agricultural experiment stations are conducted with special reference to the agricultural needs of their respective States and Territories. This inquiry

has shown conclusively that by far the largest part of the work of our stations has direct relation to the important agricultural interests of the communities in which they are located. It has also shown that the nature of the operations of the stations is becoming better understood by our farmers, and that the desirability of more thorough and far-reaching investigations is much more appreciated than formerly. A broader and deeper foundation of scientific inquiry is being laid each year, and there is a constant accumulation of data regarding the general agricultural conditions of the different regions of the United States. The climate, soil, water supply, native and cultivated plants, injurious insects, fungi, and bacteria are being studied in more detail and with greater thoroughness than ever before. Best of all, this scientific work is having a beneficial effect on more practical operations of our stations. These are assuming a more substantial and systematic character, and are being conducted with more definite relation to actual conditions. They have, therefore, a greater assurance of successful practical outcome.

Questions relating to the introduction of plants or to the improvement of the live-stock industry in any region, for example, are now being investigated with a strict relation to the real requirements of the agriculture of that region, which would have been impossible a few years ago. Public attention has recently been strongly and favorably attracted to the successful results of the work of our stations, in cooperation with this Department, in making it possible for our farmers to have an abundant supply of forage for their live stock under varied regional and climatic conditions. The relatively large use which is now made of such crops as alfalfa, kafir corn, cowpeas, and rape is generally acknowledged to be due to the persistent and well-directed efforts of the stations and this Department. This is a matter of very great importance to our agriculture when we consider the vast interests involved in the animal husbandry of the United States.

In some ways the past year has been notable in the progress of agricultural research in this country. The results of practical importance already attained have inspired the public with such confidence in the value of this kind of investigation that Congress and State legislatures have been unusually liberal to this Department and the experiment stations. At the same time business enterprises requiring scientific and expert knowledge and skill for their successful management have been unusually prosperous. The managers of these enterprises have awakened to a much clearer appreciation of the value of the services of such men as are most successful workers in our institutions for agricultural education and research. An increasing number of our best workers in these institutions have therefore been given very attractive offers from the business world. So many public and private positions for well-trained and experienced workers in agricultural science and

research have been opened that in some lines the demand has outrun the supply. This has led to numerous changes in the personnel of our experiment stations, partly through the transfer of their officers to outside enterprises and partly through the change of officers from one station to another on account of differences in salary and other attractions. This is a remarkable state of things considering the length of time during which our stations have been in operation, and brings them face to face in a measure with the same difficulties which attended their earlier operations, when, for different reasons, there was an inadequate supply of trained workers.

As the work of the experiment station makes a more definite impression upon the public mind, and is more clearly differentiated from that of the agricultural college as a whole, the State legislatures are called upon to make special appropriations for investigations by the stations. A notable example of this was the action of the recent legislature in Illinois, which appropriated $46,000 for the next two years, to be expended as follows: Experiments with corn, $10,000; soil investigations, $10,000; investigations in horticulture, $10,000; experiments in stock feeding, $8,000; dairy experiments, $5,000, and sugar-beet experiments, $3,000. A number of States recognized the special agricultural needs of different localities by appropriations for substations or independent stations devoted to these interests.

In further recognition of the experiment station as a distinct unit within the college, separate buildings or parts of buildings are now more generally provided for the exclusive use of the station. The movement for the separation of the office of director of the station from that of president of the college has also been advanced by changes in this direction in six States, leaving at present only eleven States and Territories in which the college president actually performs the functions of director of the experiment station. In a number of instances newly appointed officers of experiment stations have no duties as teachers in the college, and in other instances changes have been made by which the amount of teaching required of station officers has been materially reduced. Experience has each year shown more conclusively that if station officers are to accomplish the best results in agricultural investigations their research work must be made their primary business before which routine duties of every kind must give way as the conditions of the original work demand. Our most successful stations are now managed on the principle that they constitute research departments of the colleges; that they are thus at the summit of our system of agricultural education, and that they must be managed on the same principles as those upon which the scientific laboratories in this Department and our leading universities are conducted—that is, their officers must be the best trained experts in their respective lines, and they must be able to devote their time and energy quite fully to their investigations.

COOPERATION OF THE STATIONS WITH THE DEPARTMENT.

The number and variety of cooperative enterprises between the different Bureaus and Divisions of this Department and the experiment stations have greatly increased during the past year. Progress has also been made in determining the principles on which successful cooperation must be based and the best methods of arranging and conducting such cooperation. Without doubt the Department and the stations are now in closer touch than ever before, and through their cooperation important investigations for the benefit of agriculture in many parts of the country have been greatly strengthened. Now that the preliminary questions relating to the organization of these cooperative enterprises have been largely settled and the funds which can be devoted to this kind of work have been increased, there will be a further extension of cooperative effort in the immediate future. By this combination of forces the varied national and local needs of our agriculture will be more fully met, and the benefits of agricultural research will be extended to every part of our territory. Thus we shall have a system of agricultural investigation more thorough in its organization and more wide reaching in its scope than exists anywhere else, and this vast system for the direct application of the results of scientific inquiry to agricultural practice has been so constituted that every farmer throughout the length and breadth of our land may easily and freely avail himself of whatever information is gained through the researches of this Department and the stations.

AGRICULTURAL EXPERIMENT STATIONS IN ALASKA.

Agricultural investigations in Alaska have been continued, with headquarters at Sitka and subsidiary stations at Kenai, on Cook Inlet, and Rampart, in the Yukon Valley. The chief new feature of these investigations during the past year has been the more thorough study of the agricultural possibilities of the interior, especially the Yukon Valley. For this purpose Professor Georgeson, the agent in charge of the Alaska experiment stations, made journeys into the interior during the summers of 1900 and 1901. As the result of the first of these journeys a tract of land on the north side of the Yukon River, directly opposite the town of Rampart, was selected for experimental purposes, and field experiments with rye, barley, oats, wheat, and vegetables were inaugurated. Rye seeded in the fall of 1900 wintered perfectly and was ripe early in August, 1901. Barley sown in the spring of 1901 ripened at the close of that season. Vegetables were largely destroyed by rabbits, and even those which escaped did not grow well in a new soil, confirming previous experience that it requires two or three years in Alaska to get new soil in proper tilth for vegetables. Vegetables are, however, successfully grown at the Holy Cross Mission and other points in the Yukon Valley. Professor

Georgeson reports that while he was at the Holy Cross Mission during the second week in August, 1901, "the mission was supplied from its own garden with new potatoes, cauliflower, cabbage, and other vegetables." At Sitka the experiments with cereals, forage crops, and vegetables were continued, and a considerable number of varieties were successfully grown. A log silo was also built there and filled with native grasses during the latter part of September, 1900, of which Professor Georgeson says: "The experiment was an entire success. Our work oxen were fed exclusively on silage from November 10 to May 1, and only when they were worked were they fed grain in addition. They ate the silage with relish throughout and were maintained in good condition. There was no greater loss of silage by waste than always occurs in preserving green forage."

At Kenai experiments with cereals and vegetables have been continued, with considerable success. Fall-seeded wheat survived the winter of 1900–1901 in fair condition, and spring-seeded oats, barley, buckwheat, flax, and wheat looked very promising early in September, 1901. A small plat of red clover sowed in the spring of 1900 wintered over well and made a good growth during the summer. The greater portion of the grain sown last spring at this station was from grain previously grown there, showing that grain can be matured and propagated in that region. Besides the experimental work at Sitka, Kenai, and Rampart, seeds have been distributed to over 400 persons living in different parts of Alaska, and a considerable number of reports have been received from seeds grown there during the season of 1900. There is a considerable increase in the demand for seeds, now that it is known that they are being distributed through the station. Not only are vegetables, cereals, and forage plants asked for, but there is a considerable demand for flower seeds. There seems to be a great desire on the part of a certain class of settlers in Alaska to cultivate flowers, which are more than ordinarily prized in a region where the general conditions of life are so comparatively hard.

WORK OF THE STATIONS AT SITKA AND KENAI, ALASKA.

During the summer of 1901 the assistant director, Dr. E. W. Allen, of the Office of Experiment Stations, made a tour of inspection to the stations at Sitka and Kenai, and also made inquiries regarding the agricultural possibilities of the coast region of Alaska. The following extracts are taken from his report:

The impression which I gained from this Alaskan trip was that not only is quite a wide range of gardening and some measure of agriculture possible, as has been shown by the Congressional reports of our experiments there, but that a gratifying amount of educational and demonstration work has been done among the people, which is already productive of good results. A number of private residences about Sitka show what can be accomplished by well-directed industry in beautifying them and in maintaining creditable home gardens. Many of the natives plant gardens of

vegetables and flowers, and a considerable number give them fairly good care. Near the town men were engaged in making hay on a small tract, and, with the weather prevailing at the time of my visit, it was quite practicable to dry the hay in the field. Numerous gardens containing lettuce, radishes, cabbage, peas, potatoes, and the more hardy vegetables generally were to be seen at the various places where I landed along the way. These gardens were for the most part well cared for and usually an object of pride. The quality of the vegetables raised was said to be excellent, and failures were few with persons who understood the best methods. At Kenai the gardens of the natives presented an especially well-cared-for and thrifty appearance. In many places the natives have come to appreciate the value of vegetable food in improving their diet, and the variety which a garden of fresh vegetables lends to the food of the newer residents of Alaska is much appreciated by them. Flower beds of sweet peas, peonies, and a number of other kinds of plants were not uncommon.

The seed for planting these gardens and the directions and encouragement for maintaining them have come very largely from the special agent in charge of the Alaska station and his superintendents. Everywhere I went along the coast region I found that the work of the Alaska stations was well known and usually very favorably regarded at present, although many admitted that they at first viewed the undertaking with much skepticism. Hardly a man was addressed who did not know about Professor Georgeson and his work. This is the more remarkable, and stronger evidence of the interest which has been aroused, when it is considered that there are practically no newspapers in Alaska having more than a local circulation, that no publications except Congressional reports have been issued, and that, owing to the difficulties of transportation, people do not get about as much as they do in the States. The extent to which information has been diffused and the confidence of the people won speak much for the vigor and industry with which the work has been prosecuted. The propaganda has met with a good measure of success, and the work now has many strong friends, particularly in the western coast region, where the conditions are the most suitable for agriculture.

I was impressed with the many difficulties which our agent has had to meet in carrying on his work under such pioneer conditions at a number of points widely separated. Transportation is entirely by water and is slow, mails are infrequent, the need for materials of various kinds must be anticipated several months, labor of the right kind for our work is very difficult to procure, the results must be accomplished in a short summer season, and a thousand and one little annoyances arise to hinder and discourage the undertaking. It is only through untiring energy and enthusiasm for the work and the exercise of the strictest economy that Professor Georgeson has been able to make the good showing that he has for the time and money he has had at his disposal. I do not hesitate to say that, despite these difficulties and the higher prices to be met, few if any of our experiment stations in the early years of their existence have been able to make a better showing for the money expended, in the way of buildings, permanent improvements to the land, and amount of experimental work performed, than the Alaskan stations do to-day, and the interest and confidence which have been aroused by the stations are worthy of any station in the newer States.

Now that such favorable results have been obtained with vegetable growing and some of the cereals, I am of opinion that work might be undertaken with animals to show the extent to which feed for them can be profitably or economically grown in Alaska. Fresh meat is scarce and dear. It is only occasionally that meat can be obtained to the west of Sitka. With small animals, like poultry, useful work might be done in showing what feeds can be grown for them and how they can best be cared for. Poultry raising would be the simplest beginning in animal production and might lay the foundation for work with larger animals. The hog is not commonly found, but summer pasturage for hogs could surely be raised, and it seems very probable

that winter feed could be grown also. The profitability of hog raising in a small way and the quality of the pork which could be produced without corn would be a good subject for investigation. Cattle raising and milk production have been tried as a business venture on a small scale at a few places. In most instances, however, the feed for the animals has been very largely shipped in, and it remains to be demonstrated to the satisfaction of the people at large at least that the necessary grain and feed can be profitably raised, so that products of good quality can be made without relying upon feeds imported from Puget Sound.

From the experience already had I am inclined to regard the raising of cattle for beef and for milk production in Alaska as entirely feasible. There are good pastures in places and natural meadows where hay of good quality can be made. From a commercial point of view the present freight rate on live cattle from Seattle to the Cook Inlet region would give the local cattle raiser the advantage of a protective tariff. Kenai and Kadiak seem well adapted to experiments of this nature and are representative of quite large areas of country. I would recommend that the building up of a herd of cattle with reference to conducting experiments in the feasibility and profitability of beef and milk production, using home-grown products to the largest possible extent, be taken up as soon as circumstances and the funds at the disposal of this work will permit.

From all the evidence received at this Department it seems clear that the agricultural investigations already conducted in Alaska have been productive of good results, and that by persistent effort sufficient agriculture may be established in this Territory to be an important aid in the development of mining, lumbering, and fisheries. To put the work of the stations on a more effective basis, funds should be provided for the completion of the headquarters building at Sitka, the erection of buildings at Kenai and Rampart, and the further equipment of the stations there, for the employment of an expert horticulturist, whose services are greatly needed, and for the purchase of live stock. The annual appropriation for the regular expenses of the Alaskan work should be at least as much as that for the experiment stations in the other Territories, namely, $15,000. For the ensuing fiscal year I recommend that an additional appropriation of $5,000 be made for buildings and the purchase and transportation of live stock.

AGRICULTURAL EXPERIMENT STATION IN HAWAII.

The first appropriation ($10,000) for the establishment and maintenance of an agricultural experiment station in the Territory of Hawaii was made for the fiscal year covered by this report. With a view to determining the conditions existing in Hawaii with reference to experimental investigations as related to the needs of the agriculture of that Territory and the location of an experiment station, Dr. W. C. Stubbs, director of the Louisiana Agricultural Experiment Stations, was sent to Hawaii, as stated in my previous report, where he made a careful investigation with special reference to the organization and work of an experiment station. His report was transmitted to Congress in January, 1901, and published. Besides much valuable information regarding the agriculture of Hawaii, this report contains definite rec-

ommendations regarding the location, equipment, organization, and lines of work of the proposed experiment station in that Territory. It was recommended that the station be established under the direct control of this Department and independent of existing local institutions. As the station already maintained by the Hawaiian Sugar Planters' Association will continue its work on problems relating to the sugar industry, it was recommended that the station to be established by this Department give its attention to other agricultural interests.

It was pointed out that among the subjects to which the station should give special attention were the culture of fruit, vegetables, rice, forage crops, stock raising, dairying, coffee growing, irrigation, and forestry. As the headquarters for the station, it was recommended that the reservation which the Hawaiian Government had surveyed and mapped in 1893 for an experimental and forestry station be secured. This is a tract of 222 acres near Honolulu, known as Kewalo-uka, with an elevation ranging from 50 to 1,000 feet and containing cleared and forest land. On the basis of this report a second appropriation of $12,000 was made for the maintenance of an experiment station in Hawaii during the current fiscal year. Immediately on the passage of this appropriation act I took measures for the establishment of an experiment station in Hawaii on a permanent basis. As in the case of the stations in Alaska, the general supervision of the Hawaiian Experiment Station was assigned to the Director of the Office of Experiment Stations. As the active manager of a new station Mr. Jared G. Smith, chief of the Section of Seed and Plant Introduction of this Department, was selected and transferred to the Office of Experiment Stations as the special agent in charge of the Hawaii Experiment Station. He left Washington near the end of March, 1901, and proceeded without delay to Honolulu, with instructions to establish headquarters there and to begin the organization of regular experiment-station work.

As a site for the station he was to secure possession of the tract of land in Honolulu known as Kewalo-uka, and on this to begin the clearing and fencing of land and the erection of buildings. In making plans for experimental work he was instructed—

> to consider especially the needs of the people of the Hawaiian Islands as regards the production of food supplies for home consumption, and the development of animal industry, dairying, and coffee culture, and to extend aid to the people of the different localities throughout the islands for the improvement and development of local agricultural industries through the distribution of seeds, plants, and publications, the giving of advice by correspondence and otherwise, and the institution of cooperative experiments.

He was urged to enlist the cordial support and sympathy of the Hawaiian government and people in this enterprise, and he was to announce that it would be the policy of the Department "to encourage the granting of financial assistance to the station by the Hawaiian

government, as in the case of the other States and Territories where the national funds have been largely supplemented by local grants of money for buildings, equipment, and current expenses of the station."

On examination of the records of the Hawaiian government before the annexation of this Territory to the United States it was found that while there were evidences of the intention of that government to reserve the Kewalo-uka tract for experimental purposes, the reservation had never actually been completed. Soon after the annexation of the Territory, on recommendation of the Secretary of the Navy, the President issued a proclamation (November 10, 1899) reserving 20 acres, more or less, of the best agricultural land of this tract as a site for a naval hospital, and on recommendation of the Secretary of the Treasury another reservation of 7 acres has been similarly made as a site for a hospital for the Marine-Hospital Service. Through the courtesy of the Secretary of the Navy, this Department has been granted the temporary use of the naval hospital site for experimental purposes. After negotiations with the government of the Territory of Hawaii, the larger portion of the Kewalo-uka tract was definitely set aside in proclamations issued by the acting governor of the Territory for the use of the experiment station, to be conducted under the direction of the Secretary of Agriculture.

About 50 acres of land have been cleared, and half of this area has been plowed and harrowed. This includes 13½ acres of forest land on the upper portion of the reservation, where there is sufficient rainfall to make it possible to carry on experiments without irrigation. This will be devoted to horticultural plantations, and in this way will be covered with trees again. A water system has been provided by the erection of several large tanks, which are connected with the city water system and operated with the aid of a gasoline engine and pump. The following buildings are in process of erection: Residence for the special agent in charge, office and laboratory, one frame cottage and two grass huts for laborers, one stable, and one covered manure pit.

Plantings of taro, the principal food plant of the islands, have already been begun with the special object of studying a disease which plays havoc with that crop. This is an important matter, as probably 50 per cent of the working population in these islands depend on taro for their daily food, and within the last decade the price of taro has increased 500 per cent because of the losses from this disease and the attendant deterioration in quality and yield of crop. There are many other fungus diseases of fruits and vegetables prevalent on the islands in Hawaii which should be studied. Some poultry experiments have also been inaugurated, with a view especially to finding a way of raising healthy barnyard fowls in these islands, where hitherto the supply of poultry has kept below the demand because of the losses from the ravages of diseases. It is reported that live chickens sell in

Honolulu markets for $15 a dozen, and eggs at from 40 to 50 cents a dozen. Owing largely to the insufficient supply of forage, pork production is very expensive, the ruling price for hogs in the Honolulu markets being from 10 to 17 cents a pound on the hoof. To remedy this difficulty experiments with various tubers and roots and with the common Papaya as feed for swine will be undertaken at an early day, and as soon as possible investigations in dairy husbandry will be inaugurated. Plans are also being made for experiments in horticulture, including both fruits and vegetables, and coffee culture.

Among other subjects needing the attention of the station are investigations on methods of cultivation, use of fertilizers, drainage, irrigation, and forestry. Considering the variety of subjects for investigation, the annual appropriation for the maintenance of the Hawaii experiment station should be not less than $15,000. To properly equip it with buildings, apparatus, implements, live stock, etc., a special fund of $10,000 is very much needed. Now that Hawaii is organized as a Territory of the United States, I see no good reason why in the matter of an agricultural experiment station it should receive different treatment from that accorded other Territories—that is, it should regularly receive the same appropriation as is given the other Territories under the act of Congress of March 2, 1887. The further needs of the experiment station, especially as regards land, buildings, and equipment, should be provided by the people of the Territory, acting through their Territorial legislature.

PORTO RICO AGRICULTURAL EXPERIMENT STATION.

The first appropriation for agricultural investigations in Porto Rico was made for the fiscal year ended June 30, 1901. This appropriation was $5,000 and authorized the Secretary of Agriculture to determine the agricultural conditions existing in that island, with special reference to the most desirable localities for agricultural experiment stations, as well as the subjects on which the agricultural people of the island are in most immediate need of practical information, and how this need can be most economically and effectively supplied, but it did not provide for the establishment and maintenance of an experiment station.

The preliminary investigation called for by this appropriation was made through the Office of Experiment Stations by Prof. S. A. Knapp, who visited Porto Rico during the summer of 1900. His report was transmitted to Congress and published. It contains a summarized statement regarding the climate, soil, and agriculture of the island, shows in what ways the experiment station might benefit agriculture, and recommends the establishment of a station as soon as practicable. On the basis of this report Congress made a second appropriation ($12,000) for the current fiscal year, and authorized the Secretary of Agriculture to establish and maintain an agricultural experiment

station in Porto Rico. As soon as this appropriation was made measures were taken for the establishment of the station in Porto Rico. The general supervision of this station was assigned to the Director of the Office of Experiment Stations. As the active manager of the station, Mr. Frank D. Gardner, assistant in the Division of Soils, was selected and appointed special agent in charge of the Porto Rico experiment station. He proceeded to Porto Rico about the middle of May, 1901, and after spending some time in familiarizing himself with the conditions and needs of agriculture in the island he has arranged to undertake preliminary investigations on coffee culture.

SELECTION OF EXPERIMENT STATION.

As regards the permanent location of the experiment station, more difficulty was experienced in obtaining suitable land than was anticipated. As there is no Government land available, it will be necessary to purchase land for this purpose. An effort has been made to secure donations of land from the municipalities in the island. It was found, however, that either the municipalities possessed no lands that in kind and amount would be suitable for the purpose or that their financial condition would not allow them to purchase land for the station. It was therefore determined that action in this matter should be deferred until the next meeting of the insular legislature, when an effort will be made to secure local financial aid in the establishment of the station, as in the case of the other States and Territories. Meanwhile the headquarters of the station will be maintained at San Juan, and such investigations will be undertaken as can be pursued on lands leased or loaned by residents of the island desiring to engage in cooperative work with the station. Information regarding the agricultural needs of the island and methods which may be adopted for the improvement of agriculture on the basis of our present knowledge will be collated and published, and the people will be aided in this and other ways to improve the agricultural conditions. It is hoped that before the beginning of another fiscal year the question of the permanent location of the station may be settled and that then it may be possible to proceed rapidly with the erection of buildings, the equipment of the station with apparatus, implements, and live stock, and the making of horticultural and other plantations, as well as the institution of experimental inquiries which will place this station on a par with the others in the United States. For the regular maintenance of an experiment station in Porto Rico, as elsewhere, not less than $15,000 will be required annually. I therefore recommend that Congress appropriate this sum for the Porto Rico station for the ensuing fiscal year.

AGRICULTURAL INVESTIGATIONS IN THE PHILIPPINES.

It is, in my judgment, very desirable that agricultural investigations should be undertaken in the Philippine Islands under the War Depart-

ment, and in cooperation with this Department. The need of such investigation is illustrated by the fact that such an important crop as rice, the leading breadstuff of the island, is not at present produced in sufficient quantities to supply the local demands. The growing of rice is better understood by the people generally than any other crop, yet by their primitive methods of culture and crude implements they are unable to adequately supply their own necessities. Of agricultural products—mostly food stuffs—up to 1890 there were imported annually more than $4,000,000 worth, while the exports amounted to about $14,000,000, principally hemp, sugar, coffee, and tobacco. Under the Spanish Government attempts were made to establish agricultural schools, experiment stations, and model farms, but these institutions do not seem to have exerted any important influence for the improvement of agriculture, and since the American occupation have been largely discontinued.

In instituting agricultural investigations in the Philippines it is desirable, in my judgment, to follow the precedents already made in the cases of Alaska, Hawaii, and Porto Rico—that is, a preliminary investigation should be made to determine where the experiment station should be located and what subjects it should first undertake to investigate. With headquarters for agricultural investigations once established and a single experiment station well organized, it would be easy to extend the work of agricultural research so that it would take into account the special needs of different localities. In order that there may be no delay in establishing the station after the preliminary investigation is completed, I recommend that an initial appropriation of $15,000 be made for the ensuing fiscal year to enable me to institute agricultural investigations in the Philippines, and if feasible to locate and maintain an agricultural experiment station there. In order that these investigations may be begun at an early day, one-third of this amount should be made immediately available.

AMERICAN INSTITUTIONS FOR AGRICULTURAL EDUCATION.

Considerable progress has been made during the past year in broadening and strengthening the agricultural courses in our agricultural colleges. The movement for the division of the general subject of agriculture into specialties to be taught by different instructors still continues. The committee on methods of teaching agriculture of the Association of American Agricultural Colleges and Experiment Stations, of which the Director of the Office of Experiment Stations is a member, has completed its syllabus for a college course in agriculture by presenting courses in agrotechny (especially dairying), agricultural engineering, rural economics, animal husbandry, soil physics, plant pathology, and agricultural chemistry. Thus far, comparatively little attention has been given to several of these branches of agricultural

nstruction in our colleges. There are, however, beginnings of a novement for the regular establishment of such courses, which there s good reason to believe will grow with the increase of the resources of these institutions and the demands of the people. There has been a considerable increase in the total number of students attending agricultural courses in the colleges, but college faculties have in many cases failed to offer sufficiently attractive four-year courses to induce students to attend, or the trustees have failed to equip faculties with teachers who have mastered their specialties. There is a growing demand for this education, and where it does not exist the college should create it as in duty bound. There is an increasing demand for short and special courses, and the colleges are meeting this to a greater extent than ever before. A much larger amount of college extension work in agriculture is now being done. In the States in which this work has been in progress for a number of years it is being successfully continued, and institutions in other States are following the example of the pioneers in this line of education. In providing for maintenance and new buildings at the agricultural colleges, the various State legislatures meeting during the past year have been more than usually liberal, so that in the aggregate there is a large increase in the resources of these institutions.

One of the most hopeful signs of progress in agricultural education is the movement for the establishment of secondary schools of agriculture and the introduction of nature study and the elements of agriculture into the rural schools.

This Department is already giving aid to the rural schools in various ways, but I believe that the time has come for the Department to take a more active part in encouraging the introduction of nature study and elementary agriculture into the curricula of rural schools for the purpose of developing the natural tendencies of the pupils to observe and take an interest in the natural phenomena surrounding them and of fostering in them a love for the country and its pursuits.

Much encouragement may be given by distributing seeds and plants for use in establishing school gardens; by furnishing schools with collections of specimens of beneficial and injurious insects, plant diseases, and other illustrative material; by supplying teachers with the publications of this Department which will be useful to them, and by such other means as would suggest themselves as the work progressed. Without doubt, the improvement of our rural schools, so that every child throughout the length and breadth of our land may have an opportunity for education which will prepare him for good citizenship and most efficient industrial service, is one of the greatest which should engage the attention of our people. With the increased interest in country life which is beginning to be manifested in different parts of the country, there is good reason to hope that our rural

schools will be much improved in the near future, and especially that they will be so organized and maintained that in them the children will be shown the attractive side of country life and will be taught the dignity and worth of rural occupations, so as to incline them toward the study of the sciences that relate to agriculture.

FARMERS' INSTITUTES.

The farmers' institute movement in this country has now become national in its extent and in the scope of its interests, and has even assumed international relations as connected with similar movements in other countries. Having their origin in farmers' societies of various kinds, some of which date back half a century or more, the institutes have been developed through the efforts of farmers' organizations, the agricultural colleges and experiment stations, boards and commissioners of agriculture, and many individual leaders in agricultural progress, until they are now annually held with more or less regularity in nearly all the States and Territories. Beginning about thirty years ago the States have one after another shown their interest in this movement through their legislatures by appropriations to aid the institutes. Growth of interest in the institutes among the farmers has been reflected by a steady increase in the number of States thus providing for their maintenance and by the larger amounts of money devoted to this purpose from year to year. According to statistics published by the Office of Experiment Stations, in 1891 about $80,000 was spent for farmers' institutes in the United States, and of this sum about $60,000 was specifically appropriated for this purpose. In 1899 the specific appropriations for institutes aggregated a little more than $140,000, more than twice the sum appropriated in 1891, and the estimated expenditure of funds derived from other sources was $30,000, a grand total of more than $170,000 spent for institutes that year. The statistics of the institutes for the past year have not yet been collated, but the incomplete returns already received show that the State legislatures of last winter were more liberal than ever before to this enterprise.

While the statistics of the institutes collated by the Office of Experiment Stations in 1899 were not entirely complete, they showed that that year over 2,000 farmers' institutes were held in the United States which were attended by over half a million farmers. The institutes were held in 43 States and Territories. In 19 of these they were in charge of officers of agricultural colleges or experiment stations. In 17 they were under State or county officials, and in 7 they were under the joint control of State officers and college or station officers. Successfully conducted institutes are found under each system of management.

Under different names meetings of farmers in many respects similar

to our farmers' institutes are held in other countries. In some European countries in particular itinerant instruction for farmers is very thoroughly organized.

While in some of our States the farmers' institutes are quite thoroughly organized, have liberal financial support, and reach the farmers quite widely, in many of the States and in the Territories the movement is yet in a comparatively weak condition and the organization and means for this work are inadequate. Moreover, even in the States where the institutes are most thoroughly organized and have had the greatest success, new problems relating to their management have arisen with the growth of the movement. For example, there is increasing difficulty in some States in securing workers thoroughly qualified for this kind of service who can attract large audiences of farmers and hold their attention throughout the meetings.

It is a common experience that after the institutes have been held for a number of years in a given locality the farmers are not so ready to listen to local speakers or those who have nothing to give them except what has come within the range of their own limited personal experience. They demand that the institute workers shall have a wide range of knowledge regarding the science and practice of agriculture, and particularly up-to-date information regarding the progress that is being made throughout the world in studying problems in agriculture both at the experiment stations and on the farm. This has led to a demand on the officers of our agricultural colleges and experiment stations for service at the farmers' institutes far beyond their ability to meet. There is, therefore, need of developing a class of institute workers who shall combine successful practical experience and scientific knowledge of agriculture with the ability to address large audiences of farmers in a way not only to hold their attention but also to impart to them definite information and instruction. Another problem of increasing importance relates to the ways and means of reaching the masses of our farmers through the institutes. On the supposition that 500,000 farmers now annually attend the institutes, it will be seen that out of 10,000,000 farm workers in the United States only 1 in 20 is directly reached by the institutes. These are, without doubt, in the main the most intelligent men in the business, and whatever good they receive from the institutes is disseminated to a considerable extent among their less aggressive and more careless associates. But the institutes should directly reach a far greater proportion of our farmers. To do this various expedients will have to be adopted to adapt the institutes to the needs of the different classes of our agricultural population.

These examples of institute problems have been given to illustrate the fact that this movement has now reached such a stage of its development that the comparatively simple methods hitherto followed

in the organization and maintenance of the institutes are not adequate for an enterprise of such magnitude as this has become. The solution of these problems will require much study, involving a comparison of methods employed in the different States and countries. In its national and international aspects there is, in my judgment, room for much useful work by this Department which may well aid in this as in other movements for the education of our farmers and the improvement of our agriculture. While the Department has already done something toward helping institute movements, I believe that it should be put in a position to organize work in this line more thoroughly, and I have therefore decided to ask Congress to make a special appropriation of $5,000 to enable the Office of Experiment Stations to enlarge its work with a view to giving definite aid and encouragement to the farmers' institutes in the different States and Territories. This may be done by collating and publishing information regarding the institute movement at home and abroad, by furnishing the institute workers with the Department publications and information through correspondence, by advising and assisting the institute managers in different parts of the country with special reference to perfecting organization and strengthening the work in weak places, and in general the Department may act, through its Office of Experiment Stations, as a sort of clearing house for the farmers' institute movement as it has done in the case of the agricultural experiment stations; that is, it would be a center for the focalization and dissemination of information and influences which may serve to develop farmers' institutes and make them a more efficient means for the education of our farmers and the improvement of our agriculture.

I am convinced that the publications of the Department and the experiment stations do not in themselves constitute all-sufficient means for the dissemination of information on agricultural subjects among our people. While the work of the Department and the stations has already been so far disseminated and applied that it has made important changes for the better in our agriculture, the spread of the influence of these institutions is comparatively slow because the means for directly reaching the farmers which they now possess are inadequate. The farmers' institutes may in a great measure supply this lack. When properly organized, they will bring to the masses of our farmers the information which they need to enable them to understand and apply the results of the work of the Department and the stations, and will impress upon them by practical illustrations and demonstrations the benefits which advanced scientific knowledge may confer upon our agriculture. Through the institutes, as in the case of other educational agencies, the living teacher coming in contact with the living worker can produce results which it is hopeless to expect from printed documents, however well written and illustrated.

INVESTIGATIONS ON THE NUTRITION OF MAN.

The investigations on the food and nutrition of man during the past year have included dietary studies and cooking, digestion, and metabolism experiments. They have been conducted in various parts of the United States in cooperation with the experiment stations, agricultural colleges, and universities. Seven technical bulletins, two farmers' bulletins, and a Yearbook article on these investigations have been published during the past year.

The evidences of popular and scientific interest in investigations on the food and diet of man continue to multiply. The results of the investigations of the Department are being incorporated in other investigations and in scientific works on this subject, and the apparatus and methods devised by our investigators are being adopted both at home and abroad. Our publications are being used in unusual extent in connection with the courses of instruction in domestic science in schools of all grades in this and other countries, and are also much sought after by women's organizations interested in the promotion of home economics.

The lines and methods of investigation of the problems of the nutrition of man have now been so far worked out that it seems desirable that some features of this work should be conducted on a larger scale than hitherto, with a view to a more definite application of their results to practical affairs. For example, while a considerable number of dietary studies have been made, these have by no means covered the variety of conditions existing in different parts of this country and among people of different occupations. A more systematic and thorough attempt may well be made to collect reliable data regarding the food habits of our people. We need especially to study the food consumption of our farmers and rural and urban wage-workers in different regions, with special reference to their hygienic and economic requirements. Again, it is believed that the results of nutrition investigations already made may be practically and beneficially applied in a wide way to the feeding of man wherever a considerable number of persons are to be fed on a systematic plan. This applies especially to boarding schools, college clubs, reformatory and penal institutions, and hospitals for the insane and other dependent classes.

A beginning has already been made in this direction, but there is still room for a large amount of investigation before definite suggestions of general application can be made. The importance of this subject may be illustrated by reference to the hospitals for the insane in the State of New York, in which the special agent in charge of our investigations has already made some studies under State auspices. The annual cost of the food supply to these hospitals has been over $1,000,000. The investigations already made show that not only may the total cost be

considerably reduced and large wastes prevented, but that the dietaries of the inmates of these institutions may be much improved by attention to the facts and principles established by nutrition investigations. These preliminary investigations have also shown the need for more accurate inquiries regarding the food requirements of different classes of persons in these institutions. In the State of New York alone not far from 100,000 people of the dependent and delinquent classes are maintained in public institutions at an annual expense of $26,000,000, of which about $6,000,000 is expended for food. This will give some indication of the vast interests at stake in this matter when we take the whole country into account. Certainly here is a field of investigation upon which the Department might well enter, and in which results of great practical value might be expected.

For the extension of nutrition investigations in the two lines above mentioned, namely, (1) dietary studies of farmers and rural and urban wage-workers, and (2) studies with reference to the utilization of the results of nutrition investigations in public institutions, I indorse the recommendation of the Director of the Office of Experiment Stations that $5,000 be added to the present appropriation for the nutrition investigations.

Now that the governmental, commercial, and other interests of our people are so largely concerned with tropical regions, the determination of the food habits and requirements of people living in such regions has become a matter of much importance. The continuance of soldiers, sailors, and civil officers of the United States in such regions would of itself justify the institution of investigations to determine the best dietaries for their use while there. With our rapidly expanding commerce and the going out of considerable numbers of our people to reside in tropical regions, there is additional reason for undertaking such studies. Moreover, we need to study the dietaries of the native populations which have recently come under the control of the United States, with a view to determining the relation of their food habits to their health and industrial efficiency. Such investigations may easily become an important factor in the agriculture, trade, and commerce of these regions, as well as in the formulation of plans for the improvement of the conditions of life among these peoples. I have therefore indorsed the recommendation of the Director of the Office of Experiment Stations that a special appropriation of $5,000 be made to enable this Department to undertake studies of the food supply and consumption of people living in the Tropics.

IRRIGATION INVESTIGATIONS.

The irrigation investigations conducted through the Office of Experiment Stations have been extended during the past year as far as the appropriation of $50,000 would permit. These investigations have

followed two general lines in accordance with the terms of the appropriation act: (1) Studies of irrigation laws and the social and industrial institutions of irrigated agriculture; (2) investigations of the methods by which water is conserved, distributed, and used.

IRRIGATION LAWS.

The significance of the facts disclosed by the study of irrigation laws can be appreciated only by those familiar with Western conditions, which are in striking contrast to those of the East. In the East moisture comes from the clouds; in the West farmers must secure it from other sources. In the East irrigation may supplement rainfall; in the West it must take its place. Not only is the availability of streams for irrigation the measure of settlement, but the character of the social and industrial life of those who depend upon them will be profoundly influenced by the laws and customs which govern the ownership and control of water.

The most impressive fact connected with irrigated agriculture is the dominating influence of streams on the peace and success of cultivators of the soil. The character of the titles to water finally recognized will do more than all other influences combined to determine whether Western farmers are to be tenants or proprietors. This makes it of vital importance that the disposal of the water resources of the West should be hedged about by every safeguard which experience can suggest. Every consideration which justified the General Government in organizing a bureau for surveying, mapping, and disposing of the public lands applies with equal force to the orderly and just establishment of titles to water by public authority, either State or national.

Unfortunately, however, the importance of this was not recognized at the outset, hence the management of the public land has no counterpart in the disposal or division of Western rivers. Whoever desires to acquire public land can learn from official records just what land is open to entry and what has been disposed of. The need of reliable information regarding the amount of water appropriated and the amount still remaining under public control is more urgent, because men can see with their own eyes what lands have been settled upon and improved, but the appearance of a river gives no clue to the ditches which divert it 50 or 100 miles above or the claims which may be filed on its waters below.

Thus far all of the laws governing water rights in irrigation have been passed by the States, and all of the titles to water thus far established are either the creation of State statutes or the results of decisions of State courts. A few States have enacted enlightened codes of water laws. In these the water-right records are a reliable guide to those seeking to irrigate land and a protection to those who have already done so; but there are other States where investors in irriga-

tion works and incoming settlers must depend on what they see or on the statements of other settlers in determining what is their prospect for securing the water supply needed in irrigation. Neither of these sources of information can be relied upon. As a rule, those who have rights to water do not encourage the filing of additional claims and are inclined to say that all the water is appropriated, while newcomers are inclined to believe, if there is any water running in the stream, that it is open to their use. The tendency, therefore, is to build more ditches than the stream will serve, but it is especially marked where conditions for ditch building are favorable. As there are no limitations on the number of claims which may be filed or the number of ditches which may be built, the establishment of new rights goes on until there is not water enough to fill all the ditches, when controversies and conflicts inevitably arise. For such conflicts the only means of settlement thus far provided is a resort to force or the courts. In the States where rights to water are determined by ordinary suits at law, litigation is almost continuous and is exceedingly burdensome. It too often happens that such suits, instead of settling the nature of water ownership, only create new issues, which in turn burden the courts and impoverish water users.

This condition of affairs should not continue. The growing demand for water for irrigation purposes, the greater needs of cities and towns for domestic uses, the importance of streams in the generation of power, are making it absolutely necessary that some simple and final method of determining and protecting rights to streams shall be provided. This Department is lending all the aid its means will permit to bringing this about, and with most encouraging results. No feature of these investigations has met with more appreciative recognition than the study of water-right problems, and the meritorious character of the laws enacted last winter by several arid States and Territories shows that the Department's work is bearing fruit. The importance of these investigations is not to be measured, however, by results already achieved, but by their influence on the future social and industrial life of the West.

The report on irrigation in California recently published by this Department presents an impressive picture of the manner in which development has been hampered by lack of adequate water laws. The chaotic and conflicting records of claims, the uncertain limitations on riparian rights, and the failure to protect all rights by the public division of the water supply in times of drought has been a source of anxiety to the user and of expense and loss to the not less worthy owner of ditches and canals. The marvelous natural advantages of the State have been sufficient to offset these drawbacks, but the larger and better use of water in the future is dependent upon their removal. Especially is this true if the Government is to construct irrigation works.

Under present conditions no one knows who would control the water made available by public funds. No one knows whether the needy user or the speculative holder of a water title would reap the benefits of this expenditure. The report on irrigation in Utah, soon to be published by this Department, shows with equal clearness the need of laws to insure stability and justice in the distribution of the water supply. These reports will be followed by similar investigations in other arid States. They will present the facts. With these before them the people of each State can determine what action, if any, is required.

Reform in irrigation laws will be final and satisfactory only when it comes through the enlightenment of the people most concerned. In a matter so vitally affecting the home as the control of the water supply no legislation will be effective which has not the sanction of the irrigators themselves. As yet, this kind of agriculture is new and its requirements are only imperfectly understood. Material development has outrun the creation of institutions necessary for its protection. The last is the most difficult problem, and it is the one now directly before us. The possibilities of irrigated agriculture are so great that everything which will contribute to its largest and best development is a matter of national interest. We are now in the momentous years when institutions are forming, and the labors of this Department to foster tendencies in the right direction and to correct mistakes before they have become fixed by time and custom should be continued. What is done now affects not only the present generation of irrigators, but will vitally influence those of the distant future.

DISTRIBUTION AND USE OF WATER.

The design and improvement of instruments for measuring the water used in irrigation have received the further attention of the experts employed in this work, and have resulted in registers being furnished to irrigators at about one-half the cost of foreign instruments made for this purpose. Accurate measurement of water tends to promote economy, because it enables farmers to know whether they are receiving what they pay for and canal companies to check wasteful use wherever it occurs.

In addition to improving instruments for measuring the depth of water flowing in canals, a station has been established at Cheyenne, Wyo., for rating current meters and testing water registers. This station has been of marked service to the irrigation interests of the surrounding States.

The studies of the duty of water have been extended so as to embrace all the problems of a river. The results show that the volume of water required to irrigate an acre of land along some parts of a stream will irrigate two or three acres in other places. They also show the need of preliminary study of this subject in order to rightly locate ditches and

canals. The water supply in the same river gains in some places from seepage and loses in other places. An illustration of the change in volume due to this action was shown last season by Snake River, in Idaho. At one place in its course it carried enough water for 200,000 acres of land. Forty miles above it was dry. Nothing had been added to it by surface streams in the intervening distance. Where it was dry the water had sunk into the sand; farther down it reappeared on the surface.

The studies of evaporation and seepage have been extended in order to show more clearly the extent of the losses from canals from these sources. Much interest is being manifested in these investigations by managers of canals. Definite information on the subject is needed by those who are planning new works and to enable the managers of the old ones to distribute their water supply to the best advantage.

The operation of canals which divert streams flowing over sandy beds, or which are heavily charged with silt, has proven a source of great perplexity to those in charge, and the influence of sediment in the maintenance of reservoirs deserves careful consideration in the location of these works. Much valuable information on this subject has been gathered during the past year.

In some of the older irrigated districts the percolation of water from canals, or its wasteful use on fields, has created bogs and marshes on the lower lands. To make these over-watered fields again productive drainage will have to supplement irrigation. The plans for drainage should be made, like those for the original watering, on a comprehensive plan. The individual irrigator can not drain his own farm without the cooperation of his neighbors. Plans for effective cooperation are needed, and the aid of this investigation has been asked in their preparation.

IRRIGATION IN HUMID SECTIONS.

Interest in irrigation in the humid regions of the United States is constantly growing. This has been stimulated throughout the Middle West by the drought of last summer, and in the South and Southwest by the success of the rice industry. In the State of Louisiana more miles of irrigation canals have been built and more money expended on pumping plants during the past two years than in any arid State. The application of irrigation in growing rice in Louisiana and Texas has made land worth originally from $5 to $10 per acre worth $50 to $100 per acre, and promises to enable the United States to become an exporter instead of an importer of this important food product.

A recognition of the increased interest in irrigation in the East has caused this Department to extend its investigations in this part of the country. The experiments being made by Prof. R. C. Waters, of the Agricultural Experiment Station of Columbia, Mo., are attracting

wide attention in that State, while the investigations of Prof. F. H. King, of the Agricultural Experiment Station of Wisconsin, at Madison and Stevens Point, and of Prof. Edward B. Voorhees, of the Agricultural Experiment Station of New Jersey, will serve to show the value of irrigation in securing larger yields and providing an insurance against drought. The indications are that irrigation is to have a wide field of usefulness in many sections where it is not a necessity. Especial attention has been paid during the past year to the subject of rice irrigation, and a comprehensive report dealing with the methods of application, the cost of water, and the value of the product will soon be ready for distribution.

The fact that the United States is destined to become one of the leading irrigated countries of the world makes it especially desirable that the laws which control the ownership of streams and the methods of applying water should represent the best thought and experience of our time. Nothing can be more foolish than to continue to learn experimentally for ourselves what is already known elsewhere. The lessons of southern Europe should be placed before the growing communities of the West through reports of experts familiar with our conditions, and who can thus compare their methods and ours. The first of such investigations, embracing Italy and Egypt, is now being carried on.

In no year since Western settlement began has the prosperity of the irrigated farm been as marked as during the one drawing to a close. The high prices of cattle and sheep have contributed to the profits of the grower of forage crops. There has been a ready market and good prices for all the surplus products of the irrigated farm and garden, and these high prices have been accompanied by an almost uniform record of large yields.

AGRICULTURAL ENGINEERING.

The prosecution of these investigations has led to the study of a number of affiliated subjects, the relation of which to irrigation becomes apparent only with a thorough understanding of the situation. In one way or another the whole subject of agricultural engineering is involved. Especially is this true of the applications of power to farm work. The subject of pumping will serve as an illustration of this relation. In many places pumping furnishes the most economical and readiest means of securing a water supply. Farmers desire to avail themselves of all the experience of others before wasting any money in gathering it for themselves. Hence this Department is called on for information as to the amount of water required for a given acreage, the size of pump needed to furnish it, the cost of pumping for different depths, the kind of power to be applied, whether steam, wind, gas, water power, or electricity, the cost of machinery, the expense

of its operation, and, in general, all the aid this Department can furnish in determining in advance whether or not this kind of irrigation will pay.

The commercial importance of these inquiries can be understood only by those who realize the immense sums of money which in the last two years have been invested in pumping projects to furnish water. In the rice fields of Louisiana alone several hundred thousand dollars have been expended. This work is as yet in its experimental stage, and this Department is doing a very useful service in answering these inquiries. Another illustration of the manner in which the investigations in irrigation are naturally going into a broader field of agricultural engineering is shown in the way studies of the problems in irrigation engineering have to be supplemented by a knowledge of drainage engineering. Questions are also constantly arising regarding systems of water supply and sewerage of farms and the methods of engineering which will best promote the sanitary welfare of our agricultural people. Many inquiries are coming from Eastern States for information regarding the construction of reservoirs and advice about the handling of water in order to prevent the destructive erosion of hillside farms. We are beginning to realize that the wasteful methods of tillage employed during the conquest and settlement of this country must now give place to more scientific methods, which will restore what is lost as well as preserve what remains. In many parts of our country efforts are being made to improve the conditions of rural, as well as city and village life, by beautifying the environment of the home and the community through attention to the artistic laying out of gardens, lawns, large estates, and parks. For the performance of this work in the best manner the services of expert agricultural engineers are required, and already we find here and there engineers who are giving special attention to these subjects. In various other ways the aid of the Department is also being invoked. Without doubt, agricultural engineering is destined to have as useful a place in this country as it already occupies in European countries, and it is time that the Department should occupy this field of research and aid in the development of our agriculture along this line.

NATIONAL AID FOR IRRIGATION.

There is every reason to believe that irrigation will, in the near future, become a subject for legislation by Congress, and there are important reasons why it should have the attention of that body. Hereafter the seekers for homes on the public domain must look for them in that part of the country where cultivated crops can not be grown by the aid of rainfall alone, and where the extent of irrigation is the measure of settlement. It has been the policy of this country in the past to dispose of its public lands on liberal terms, in order that men

of limited means could be enabled to establish themselves thereon. If this policy is to be continued, more favorable conditions for the reclamation of the remaining irrigable public land must be provided. The largest volumes of unappropriated water now existing are to be found in the great rivers of the West, of which the Missouri, the Colorado, and their more important tributaries are the notable examples. To make these streams available, costly and enduring dams and long and expensive main canals must be provided. If the outlay for these is to be added to the expenditure which each settler must make in building his lateral ditches, putting his land in condition for cultivation, and supporting himself and family during the period of this preparatory labor, the expenditure will be prohibitive for all except men of considerable means. Because of this, agricultural development in the West has for several years been slow, and the period of rapid progress has probably passed, even under the most favorable conditions which can be provided.

The desire of the West is not solely, however, for a more rapid agricultural growth, but a more satisfactory one. The uncertain character of water rights has already been referred to. It is the belief of those best informed that this can be remedied only by a larger measure of public control and the making of certain classes of irrigation structures permanently public works. Among the irrigation works which belong to this class are diverting dams of such size and importance as to influence the safety of all who live below them, the main trunk canals of too great magnitude and cost for private enterprise, and reservoirs built in the channels of streams used for irrigation. The argument in favor of making such reservoirs public works is that they should not be owned by private parties, because the distribution of water from them, in connection with the ordinary flow of streams, creates complications which should be averted. As their chief utility is to make possible a larger and better use of the water supply by storing the floods and supplementing the streams during the periods of drought, the same argument which justifies the setting aside of forest reserves and the payment of salaries of men to patrol them applies to the construction of reservoirs by Congress. The purpose in each case is to conserve and render available the water resources of the West.

The appropriation of money by Congress to construct any of these classes of irrigation works will bring this country face to face with a new governmental policy. Thus far we have left the diversion of streams to private ownership. The construction of public works with either State or national funds means practically a reversal of this policy and carries with it a larger measure of public control over the water resources of the West than has hitherto been practiced or sanctioned by public sentiment.

Congress, in dealing with this matter, will have to consider the man-

ner in which aid can be most effectively extended, as well as to determine the amount of such aid. It must be borne in mind that we are not at the beginning of irrigation development. Over two hundred millions of private capital has already been invested in the construction of irrigation works. The rights to streams already acquired represent many additional millions. The methods and customs by which these properties are operated and rights to streams established are the result of an evolution local in character; hence they differ widely in the different States. An illustration of the situation which prevails is furnished by the South Platte River and its tributaries in Colorado. There are over a thousand separate and distinct rights to the water of this stream. Some of these rights serve to irrigate over a hundred farms. The water right of one canal provides for the irrigation of over four hundred farms. Practically all of these thousand appropriations have reference to a common supply. Each right has a different rank, and the division, extending over thousands of miles of the main stream and its tributaries, must be carried out with reference to relative priorities. Such a division is a complex and difficult problem. It has required nearly half a century for the people of this section to solve it and devise a working system, but as a result of their experience each irrigator has come to understand his own rights and those of his neighbor, and has learned what to expect when the stream is low and what he can rely upon when it is high.

It is a question whether any appropriations which Congress might make for the construction of additional works in this district would not inflict more injury than benefit if such construction carried with it any disturbance or interference with the existing system, which people understand and to which they are attached.

The water laws of Colorado differ from those of other States. In Utah rights are established in a different manner and are of a different character, and these rights are enforced by a different body of officials. There are still other differences in Wyoming, and much more striking differences in California. This does not mean that any of these systems are entirely satisfactory. All would be improved by modification, but the change from present conditions should be made only when the people whose interests are at stake are ready for it.

The passage by Congress of any law giving the General Government control over irrigation in the West would mean, first of all, the employment of a large number of new officials and the formulation of an administrative policy to take the place of those now existing in the States. It would impose upon national officers the duty of determining what claims to water should be recognized and those which should be disregarded. As State laws differ from each other, any plan which Congress might adopt would have to be revolutionary in some States. If it were certain that the National Legislature would devise a

just and effective system which would operate everywhere alike, the unsettling of existing conditions might not be so objectionable, but there is no such assurance. All who have studied the subject agree that, notwithstanding the imperfections of State laws, it would be a mistake to attempt reforms by an arbitrary exercise of power from without, but that the true solution is to educate irrigators as to their highest interests.

If the States are to control the water supplies, there should be satisfactory assurance that whatever is made available by public funds shall benefit the actual users of water and not enrich the holders of speculative rights. In some States there is such assurance. These States are entitled to national aid, because it is known from present conditions that such aid would be clearly beneficial. But there are other arid States where the doctrine of riparian rights jeopardizes the success of every irrigation work now built, as well as any works which the Government might build. In other States rights have been established to many times the existing supply, yet there is nothing to prevent new claims being filed, new diversions made, and unending litigation over the conflicts thus created. For the Government to provide an additional supply on these streams before existing controversies are settled would simply aggravate and intensify the evils of the present situation. Whatever aid Congress extends should be conditioned on the enactment of proper irrigation codes by the States, and be made to promote the greater efficiency and success of such laws rather than interfere with their operation.

INFLUENCE OF LAND LAWS ON IRRIGATION DEVELOPMENT.

The irrigation problem of the arid West is not, however, one of water alone, but of land and water. The character of the laws which control the disposal of the 500,000,000 acres of arid public land can not but have a vital influence on the rapidity and success with which irrigated agriculture is extended. The management of these lands is a great economic trust of the nation and affords one of the highest tests of the capacity of the Republic to deal with problems of this character.

There are several directions in which land legislation can be made to promote agricultural development. Laws to protect investments of private capital in irrigation works are urgently needed. Many of the losses experienced in the past by the builders of large canals have been due to misfit land laws. The reasons for this are well understood in the West, but apparently not realized elsewhere. One has been the injury wrought by speculative filings on the land to be irrigated. The building of a canal enhances the value of the land it covers from that of grazing land to that of farming land. With a few exceptions this increase in value is at least tenfold. Under former public land laws it was possible to make filings without any outlay

except land-office fees or without making any substantial improvements, hence every canal survey has been the signal for a rush to the land office to file on the country to be watered. A majority of those making these filings were not actual settlers, but speculators seeking to make money by selling out their claims to the ditch company, or later to those who actually wished to farm the lands.

While all the land laws were doubtless intended to benefit settlers, they have in practice, in the arid region, too often benefited speculators. Hundreds of filings made under the desert, preemption, homestead, and timber-culture acts have been made by people who never were farmers and never expected to become farmers. It is to such filings that scores of meritorious irrigation enterprises owe their failure. The repeal of the preemption and timber-culture acts, and cutting down desert land entries from 640 to 320 acres, has improved the situation, but it can be still further improved by an entire repeal of the desert-land act and by requiring settlers on homesteads to cultivate as well as to live on their farms. The desert act was an economic mistake. Six hundred and forty acres is more arable land than a man of moderate means can cultivate under irrigation.

GRAZING LAND.

Surrounding the irrigable valleys are vast areas of grazing land which can never be cultivated because of lack of water, or because the surface is too broken for irrigation. Although a single acre produces little forage, the aggregate value of the pasturage is very great, and large sums of money and many men are employed in the range stock industries. Probably 400,000,000 acres of the public domain has no agricultural value except for pasturage. At present it is an open common with no laws for its protection or its disposal.

The question to be considered is whether this lack of the control of the grazing lands is an injury or an aid to the irrigation development. That it must exert an important influence can scarcely be doubted.

In sections remote from railways or local markets the prohibitive cost of transportation renders the growing of farm products for sale unprofitable. These products must be consumed where raised, and the only product that can be so consumed is winter feed for stock, and this in turn requires stock to consume it. Many irrigable areas are 50 or 100 miles from a railroad station. The use of grazing lands is as essential to successful irrigation of these areas as control of a water supply, but so long as there is no law giving secure tenure on grazing land the farmer under irrigation is subject to the danger of having his home pasturage eaten up by some nomadic flock or herd. This frequently occurs, and the gravity of the conflicts it provokes is serious. During the summer months not a week passes which does not witness an armed encounter either between settlers and range stockmen or

among the range stockmen contending for the control of the same grazing area. If, instead of this uncertain and uneconomic system, there could be a law for the control of the grazing land which would unite with a small homestead of irrigated land a larger but limited area of grazing land, thus enabling each farmer to raise his winter feed supply on his irrigated land while keeping his stock on the grazing lands in summer, the value of irrigation works would be much enhanced and a great incentive given to development by private capital.

The purpose of such union of the irrigable and grazing lands would be to divide the grazing land into a multitude of small holdings and thus increase the number of people benefited by it; to give security of tenure, which will make the growing of live stock attractive to many who are now repelled by the risks and controversies of the open range; to give increased value to irrigation, and provide the conditions indispensable to success in many localities. Such a land system would also encourage the introduction of improved breeds of stock, because it would afford better opportunities to care for them. At present there is little inducement to such improvement, because of lack of control over the country occupied. It would enlist self-interest in the improvement, or at least the preservation, of the native grasses, where every influence now tends toward their destruction.

Such a union of the irrigable and grazing lands would cause the building of fences and the making of other improvements far beyond the limits of irrigation. It would attach settlers to the pastured areas as closely as they are now wedded to their irrigated fields. It seems to possess many advantages over the present system, or lack of system, if a satisfactory law can be enacted bringing it into operation. Whatever is done, no obstacle should be placed in the way of homestead settlement, but this does not seem to offer any special difficulties. In the first place, the grazing area should be leased and not sold. The possibilities of its utilization have not yet been determined, nor is enough known to fix definitely the limits of a grazing homestead. The leasing of the grazing land in such a way as not to interfere with the homesteader can be accomplished in one of two ways: Public lands can be classified and the boundaries of irrigation and grazing defined, or the grazing land can be leased subject to entry under the public land laws. Even under such restrictions it is believed that the greater part of the grazing lands can be leased, and the rentals therefrom would amount in the aggregate to a very large sum. This could appropriately be applied to the reclamation of the irrigable lands. It would be taking nothing from the revenues of the nation, because it would come from the better use of a resource which now produces nothing.

There are also many things to commend the expenditure of the revenues derived from the sale of public lands to the construction

of irrigation works. Such an expenditure will enhance the value of the remaining lands, open up larger areas to settlement, and add to the material wealth of the country in a much larger measure than will the retention of these lands by the Government in their present condition.

The leasing value of the grazing lands has been demonstrated in a number of arid States. When Montana, Wyoming, Washington, and Idaho were admitted to the Union, a condition was attached to the donation of State lands which prevented their sale for less than $10 an acre. This was a prohibitive price, as the adjoining areas of public land could be acquired for nothing under the homestead act. Hence the only way a revenue could be derived was through their rental. As the greater part of these lands is comprised in sections 16 and 36 and only represent the value of pasture lands, they afford a fair indication of the rental possibilities of the grazing areas. The following table shows what has been done by several States in this matter, and is a significant indication of what is being lost through lack of management of the public lands of this character:

Summary showing results of leasing State lands in some of the arid States.

State.	Total area of State lands undisposed of.	Acreage under lease at close of last fiscal year or biennium.	Total rents received.	Average rental per acre.
	Acres.	*Acres.*		
Colorado	2,639,938	1,251,770	$103,121	$0.082
Idaho		32,271	23,050	.614
Montana		995,912	112,467	.112
Nebraska [a]	2,483,372	1,879,113		
Utah		106,531	6,300	.059
Wyoming		1,969,945	80,841	.041

[a] Total receipts for biennium ending November 30, 1900, for interest, rentals, bonus, etc., were $782,975.65.

In addition to these State rentals, the Union Pacific Railway in 1900 rented 428,800 acres in Wyoming and 667,520 acres in Colorado, and the Northern Pacific Railway leased over 1,000,000 acres at rentals varying from 2 to 7 cents per acre.

CONCLUSIONS REACHED.

During the past summer and preceding summers I have given much time to a personal investigation and study of the land and water problems of the West, and have reached the following conclusions regarding them:

(1) That private enterprise will have to be supplemented by public aid in the construction of certain classes of irrigation works if we are to secure the largest development of Western agriculture.

(2) That reservoirs located in the channels of running streams should be public works.

(3) That the first step toward national aid for irrigation should be the passage of enlightened codes of water laws by the States to be benefited.

(4) That the land laws should be modified by repealing the Desert Act and by requiring cultivation as well as residence on a homestead.

(5) That the nonirrigable grazing lands should be leased in small tracts so as to unite the irrigable and the pasture lands.

DIVISION OF ENTOMOLOGY.

The principal work accomplished by the Division of Entomology during the fiscal year ended June 30, 1901, is as follows:

ESTABLISHMENT OF SMYRNA FIG GROWING.

The investigations which resulted in the introduction and establishment in California of the fig-fertilizing insect (*Blastophaga grossorum*) were practically completed. An assistant was sent to Fresno in 1900, remaining there throughout the season, making observations which completed the life history of the insect and resulted in the ascertaining of important facts previously unknown, although in southern Europe the insect had been known and studied for very many years. He also took active part in the practical work of handling the insect and fertilizing the crop. Eleven tons of Smyrna figs were raised, dried, and placed on the market, and tests made by chemists and fruit experts show these figs to be superior to the imported product. The insects were successfully carried through the winter of 1900-1901, many of them hibernating successfully without cover; and, although not coming under the head of the fiscal year in question, it may be interesting to add that in the autumn of 1901 the crop of Smyrna figs was so abundant as to be difficult to estimate. Certainly more than 50 tons were gathered, and the full crop may possibly have reached as high as 75 tons. The fertilizing insect has been thoroughly established at several other points than Fresno, and the Division of Entomology now holds itself in readiness to see that a supply of the fig insects is furnished to any fig grower after he has succeeded in raising to the bearing stage caprifig trees and Smyrna fig trees.

WORK AGAINST THE SAN JOSE SCALE.

Several predatory insects have been imported from different foreign countries, and good results to American agriculture are expected. The most important of these will doubtless prove to be an enemy of the San Jose scale, which has been brought over from China.

Ever since the appearance of the San Jose scale in the United States the question of its original home has been a mooted one; and, since none of the parasitic and predatory insects of this country seem to be very efficient in destroying this scale, it has become an important point to decide, if possible, the question of the original home of the destructive insect, since it is quite fair to suppose that if efficient parasites are to be found they will be found in the original home of the scale. The importance of this quest can hardly be overestimated, since the damage which the San Jose scale has done to the fruit-growing interests of the country, especially of the Eastern States, is almost beyond estimate.

The evidence accumulating during the past two or three years had seemed to show that very possibly this scale was originally imported into this country from Japan, and in the spring of the present year the assistant entomologist, Mr. Marlatt, was sent to Japan for the purpose of studying the question on the ground. Unexpectedly to most entomologists, although not to the entomological force of the Department of Agriculture, it was quite definitely ascertained that the San Jose scale is not indigenous to Japan, but that, quite to the contrary, it was introduced into that country from the United States upon fruit stock at several different times and at several different points. The most careful search failed to reveal the scale in portions of Japan where American plants had not been introduced. Mr. Marlatt's travels in the Japanese Empire lasted about five months, and having satisfied himself, as just stated, he proceeded to China, visiting Chefoo, the port of the great foreign fruit district of North China, where the industry was started by a missionary (Dr. Nevins) some thirty years ago, since which time it has extended over the province. Foreign fruits were introduced and are now grown alongside the native fruits or grafted on native trunks. The San Jose scale was found there, but the admixture of foreign trees with the native trees prevented any conclusion as to whether the scale was indigenous or not. Proceeding to Pekin, he found the fruit markets enormously stocked and representing exclusively the products of the surrounding country and districts south of and adjacent to the Great Wall. All the fruits were native. The apples were small, and the pears were hard and woody. Nearly all this fruit was infested by the San Jose scale.

At Tientsin the same conditions were found in the fruit markets, and in the city gardens and private yards the San Jose scale was found on a flowering shrub coming from North China. In all the region between Tientsin and Pekin and the Chinese wall native fruits only are grown, and no foreign stock of any kind has ever been introduced. Apples, pears, peaches, apricots, and plums are extensively grown on the sunny slopes of all the hills south of the Great Wall. The San

Jose scale in this district could not have come from any foreign country, as there have been no importations and the fruits are all of native sorts. The scale occurs very scatteringly, although generally, just as it should if native, and is in a state of balance with its native natural enemies. It has a natural enemy, everywhere present and efficient, in a ladybird beetle known as *Chilocorus similis*. From this evidence Mr. Marlatt concludes without doubt that the San Jose scale is a native of North China. He has collected many specimens of this efficient natural enemy and has forwarded them to Washington. Steps will be taken to establish and acclimatize this important species, and it is hoped that it will prove as efficient against the San Jose scale in this country as it has in its native home. It is not beyond the bounds of probability that this importation will prove to be one of extreme value to the fruit growers of the United States.

BLACK SCALE, PLANT LICE, AND GRASSHOPPERS.

Possibly the next most important of these beneficial insects which have been introduced is a caterpillar enemy of the black scale, which has been brought over in healthy living condition from Italy by the assistance of Prof. Antonio Berlese, of the Royal School of Agricultural Entomology at Portici. The black scale is a serious enemy to olive culture in California. It occurs not only upon the olive but also less abundantly upon citrus trees, upon a shade tree known as the pepper tree, and other plants. It is the greatest drawback to olive culture in this country. The caterpillar in question (*Erastria scitula*) is found in Mediterranean regions, and is probably one of the principal causes of the comparative freedom of olive trees from black scale in that part of the world. The Division of Entomology has for eight years been attempting to bring this insect to the United States in living condition, and success for the first time was reached in November, 1901. This beneficial insect will be established in California with the assistance of the State board of horticulture of that State. It should be stated that the black scale is apparently a native of the general region from which this beneficial insect has been sent.

Another importation which may also prove to be an important one is a ladybird beetle, known as *Coccinella septempunctata*, which has been brought over from Hungary with the assistance of Prof. Charles Sajo. This insect, native to Europe, feeds upon several destructive plant lice which have been accidentally imported into this country from Europe, and upon the larvæ of the destructive asparagus beetles.

A fungous disease of grasshoppers has been imported from South Africa and has been experimentally used in different places in the United States through the summers of 1900–1901. In some localities it appears to have taken hold successfully, but it is too early as yet to predict any general success.

WORK OF LESS IMMEDIATE IMPORTANCE.

The other work may be summarized as follows: Studies of the insects affecting the violet, rose, and other ornamental plants have been completed. Extensive work has been carried on in regard to scale insects and experimental work with remedies has been conducted. The subject of the investigation of insects as carriers of diseases of human beings has been carried on, and much attention has been given to mosquitoes and house flies in this connection.

In cooperation with the Bureau of Soils, some work has been done looking toward the reclamation of brackish marshes which are breeding places of mosquitoes, and the studies of flies have indicated not only the importance of these creatures in the carriage of internal diseases, such as typhoid fever, but have indicated the cheapest and best remedies. Observations on insects affecting forest trees have been carried on during the year, and extended studies have been made of the codling-moth problem in the Northwest and of the Mexican cotton-boll weevil of Texas, information being obtained in both cases which promises practical results of very considerable importance. Extended studies were made during the summer of 1900 of the insects affecting citrus trees and fruits in southern California and a practical article detailing results was published in the Yearbook for that year. Experiments with remedies were conducted that included a series of experiments with washes against the scale insects and with fumigants both against scale insects and in storehouses, granaries, and tobacco establishments. An investigation has been made of a supposed insect damage to the cocoa-palm industry in Cuba. In apiculture comparative tests have been made of different races of bees and of methods employed in rearing queen bees.

WORK OF 1902.

Work for the fiscal year 1902 is already well under way. The investigation of the codling moth in the Northwest, as authorized by Congress, and of the Mexican cotton-boll weevil in Texas, also authorized by Congress, will be carried on through the whole year. The South African grasshopper fungus will receive further severe practical tests. Search for the original home of the San Jose scale will be continued. Advisory work with regard to the extermination of breeding places of mosquitoes will be continued, as well as many minor lines of inquiry.

OFFICE OF PUBLIC ROAD INQUIRIES.

OBJECT OF THE WORK.

In the establishment and maintenance of this Office the object has been to promote the improvement of the public roads throughout the United States. With that end in view, efforts were first directed to

ascertaining the condition of the roads, the state of public opinion in regard to their improvement, the obstacles in the way, and the best means and methods to be employed in securing better highways. Efforts were next directed to furnishing information in order that the people might be educated on this question, and to arousing interest and forming public opinion in order that practical results might be secured. Work along all these general lines has been continued up to the present.

PUBLICATIONS.

For several years after this Office was created its principal work consisted in collecting, publishing, and distributing information. This was embodied in a series of bulletins and circulars covering almost every phase of the road question. Of these publications hundreds of thousands of copies have been distributed. Some of them have been reprinted several times, and nearly all of them are still available for distribution.

The literary branch of the work of the Office is still receiving careful attention, but it is no longer the principal line of work, greater attention now being devoted to educational work of a more concrete and extremely practical character.

OBJECT-LESSON ROADS.

For spreading information and arousing interest, there is nothing equal to the practical object lesson. The Office of Public Road Inquiries has been trying to show the people the best in the good-roads line.

During the past year "object-lesson" or "sample" roads have been built in nine States. While these have not been built at the expense of the Government, nor on the initiative of the Office of Public Road Inquiries, they are the fruits of its efforts. The Office simply accepts invitations from organizations and communities to give cooperation and technical advice in the making of these sample roads.

Work of this kind produces excellent results. The demand for its extension is far greater than the Office, with its present force and means, can meet.

In the building of sample roads heretofore the machines have been loaned by manufacturers, and the railroad companies have carried them free of charge. The local community has furnished the labor and material, and the Office of Public Road Inquiries has given expert advice and supervision. The Government could, at comparatively small expense, purchase the machinery necessary for continuing and extending this work, and it seems appropriate that it should do so, thus putting this very important branch of the work on a firmer foundation.

ROAD MATERIAL LABORATORY.

The laboratory for testing the chemical and physical properties of road materials, operated with the collaboration of the Bureau of Chemistry, has been in successful operation during the year. By determining in advance the character and suitability of the material to be used in a road, this laboratory saves taxpayers the loss and discouragement resulting from mistakes in selecting materials. This work is important and practical. It will be continued and if possible enlarged.

OTHER PRACTICAL WORK.

The dividing of the United States into four divisions, with a special agent appointed for work in each, has proved advantageous. The work done by these special agents consists principally in the study of conditions, the delivery of lectures, correspondence, and preparation of matter for publication. In the Eastern Division no field work has been done because the special agent assigned to that work was placed in charge of the road-material laboratory. In the other divisions—Middle, Western, and Southern—much better results might have been secured if the Department could have kept these special agents employed all the time. This was impossible owing to the inadequateness of the sum—only $1,500 for each division—available for the payment of all expenses.

A great amount of valuable field work has been done by the Director and his assistants during the year. They have traveled thousands of miles, attended conventions, delivered lectures, and directed the building of sample roads. Their work has reached into 23 States.

The work of this Office is of great and growing importance. Popular appreciation of its efforts has greatly increased, as shown by press comments and resolutions adopted by many popular gatherings. The demand for the services of the Director and his assistants far exceeds the limits of their time and energy. There is an unmistakable popular demand that the Office of Public Road Inquiries be given a largely increased appropriation, a demand with which I am in hearty sympathy. If a larger sum should be appropriated for this purpose I believe it would be profitably expended in carrying on and extending the work of this Office.

DIVISION OF PUBLICATIONS.

In the performance of its duty to diffuse the information acquired through its several Bureaus, Divisions, and Offices the Department depends mainly upon the issue and distribution of publications. The work of the Division of Publications affords, therefore, a fair reflex of the activity and intelligence characterizing the investigating

branches of the Department, and for this reason it is important to observe that the extent of the work devolving upon it is dependent entirely upon agencies outside of the Division and beyond the control of its chief.

It is obvious, therefore, that every step taken in the development and extension of the work of the Department increases the work of the Division of Publications, and yet it must be admitted that the provisions made for the publication work and the distribution of the Department publications have never been fully adequate to the task imposed upon it. The result has been, unfortunately, that every year important reports have been withheld from publication, either until a new fiscal year has brought with it new appropriations, or until a resolution could be passed by Congress specially authorizing their publication and assuming the cost thereof. It is of the highest importance that our publications should be timely and that the practical results of investigations made—all useful information, in fact, acquired by the Department—should be promptly given to the public. These delays are not infrequently costly and are at all times vexatious. Again, in the matter of distribution, the distributing force, largely underpaid as it is, is frequently disorganized and demoralized by suspensions and furloughs necessitated by want of funds, to say nothing of grievous hardship thus imposed upon many hard-working and faithful employees. Not less than 35 persons suffered in this way last year, in spite of the fact that $5,500 of this year's appropriation was made immediately available, and it has become necessary again this year not only to ask for a very considerable increase in the force but to have a considerable sum again made immediately available in order to carry on the work efficiently to the close of the present fiscal year.

GROWTH OF THE PUBLICATION WORK.

In spite of the restrictions thus imposed upon the work of publication, it has nevertheless grown wonderfully during the past ten years. In 1893 there were issued from the Department 210 publications, aggregating over 2,500,000 copies. In the year under consideration, 1901, there were issued 606 publications, aggregating nearly 8,000,000 copies.

FARMERS' BULLETINS.

Of the above publications 3,345,000 copies were Farmers' Bulletins, of which 2,200,000, in round numbers, were distributed under Congressional orders. The total number of Congressional quotas drawn was 413. With the accumulated copies due to quotas undrawn and the increased appropriation for the Farmers' Bulletins the quota for each Senator, Representative, and Delegate for the current year has been fixed at 15,000 copies. Under the present law four-fifths

instead of two-thirds of all copies printed are available for Congressional use, and to satisfy both the Congressional and the Departmental requirements will necessitate an issue of Farmers' Bulletins aggregating a number of copies almost equal to the entire output of all publications of the past year. It has been necessary, to meet this greatly increased demand on our resources, to lease a building in the vicinity of the Department to be exclusively devoted to the storage and shipment of Farmers' Bulletins. This makes the fourth building occupied, in whole or in part, by the Division of Publications.

RELATIVE COST OF EDITORIAL WORK.

It is proper to call attention to the fact that in proportion to the total output of publications and the amount expended for actual printing, the expenses of editing, illustrating, and distributing the publications, and of the clerical work involved in the disposal of the immense mass of correspondence devolving upon this Division, as the result of the nearly 300,000 applications for publications received during the year, amount to very much less proportionately than was the case ten years ago. In fact, at no time since the Division was organized has the cost of editing, illustrating, distributing, and of the clerical work been so small in proportion to the actual cost of printing and the number of publications distributed.

THE YEARBOOK.

The Yearbook of the Department continues to be in great demand. It is difficult to keep it within the limits of a convenient book, owing to the immense variety of subjects covered by the work of the Department which should be represented in it; also owing to the mass of important information, statistical and otherwise, which finds a place in the Appendix, and which, as far as I know, is not available elsewhere. Under these circumstances the propriety of issuing the Yearbook in two volumes, the first to consist of independent articles contributed by the various bureaus, divisions and offices, and the second of the Appendix, presents itself as worthy of consideration.

The Department is subjected to great inconvenience by the smallness of the number of copies of the Yearbook placed at the disposal of the Secretary, and a more liberal allowance is urgently needed to supply the demands for this publication. When the total number of copies of the Yearbook issued was but 300,000, and when the work of the Department was not one-fourth of what it now is, 30,000 copies were allowed the head of the Department, then Commissioner of Agriculture. To-day, with 500,000 copies issued yearly, the same number, 30,000 copies, is placed at the disposal of the Secretary. Fifty thousand copies, at least, are required for the needs of the Department.

SALE OF DEPARTMENT PUBLICATIONS.

Through the courtesy of the Superintendent of Documents of the Office of the Public Printer I am able to present a report of the sale of Government publications, which shows a very large and increasing demand for the publications of this Department, even when the same have to be paid for. This fact suggests the possible—I might almost say probable—solution of the great difficulty which now attends our efforts to achieve an effectual and equitable distribution of our publications. The following table shows the number of Government publications sold and the amounts received therefor during the past four years:

Number of publications sold and amount received.

Department.	Publications sold.				Amount received.			
	1901.	1900.	1899.	1898.	1901.	1900.	1899.	1898.
Department of Agriculture	24,127	16,905	18,750	17,740	$3,220.25	$2,157.65	$2,154.45	$2,089.15
All other Departments	9,458	10,928	8,058	3,623	6,862.44	6,744.56	5,401.66	2,448.12
Total	33,585	27,903	26,808	21,363	10,082.69	8,902.21	7,556.11	4,537.27

IMPROVEMENT OF ILLUSTRATIONS.

In the enforced economy in our publication work, owing to the limited funds at our disposal, the work of illustration has unduly suffered. It has been treated more as a nonessential in a publication, however desirable it might be. In connection with the work of this Department, illustrations, though not always essential, are in many cases, when properly conceived and executed, extremely useful. The rule laid down in this branch of the work is to exclude merely ornamental pictures, and to confine illustrations to such as are desirable and calculated to facilitate the reader's apprehension of the text. It is also of the first importance that such illustrations should be the best of their kind. It has not been possible for the last two years to fulfill either of these conditions, and I have deemed it desirable to include in the appropriations for next year a special sum sufficient to pay the necessary force of artists and draftsmen, and to provide for a certain amount of illustration work over and above what we can afford to include in the regular printing fund.

NEED OF ENLARGED QUARTERS.

The urgent need of a new building is nowhere more forcibly exemplified than in the objectionable conditions under which it is necessary to carry on the work of this Division. Crowded and inadequate quarters assigned to the Division here and there—some on the main floor and some in the attic of the main building, others in widely separated

and for the most part unsuitable buildings—grievously hamper the work of the 140 persons necessarily employed in the editing, illustrating, and distributing of publications, and in the correspondence and clerical work entailed thereby.

SECTION OF FOREIGN MARKETS.

Agriculture contributed conspicuously to the remarkable expansion of American commerce witnessed during the past year. According to statistics prepared by the Section of Foreign Markets, the highest record previously attained in the exportation of agricultural products from the United States, that for 1898, was surpassed by more than $90,000,000 in the fiscal year ended June 30, 1901, when a value of over $950,000,000 was reached. Fully 65 per cent of the domestic merchandise sent abroad during the year originated on the farm.

EUROPEAN MARKETS.

Among our foreign customers in agricultural products the United Kingdom stands preeminent, taking over 50 per cent of our exports. Recent investigations by this Section into the possibility of still further increasing our trade in the British market brought out the significant fact that during the calendar year 1900 our agricultural exports to the United Kingdom, large as they were, comprised only 33 per cent of the foreign farm produce purchased by that country, leaving two-thirds of such produce to be supplied by our competitors.

In view of this fact, the desirability of procuring exact information as to the character of the agricultural imports received by the United Kingdom from countries other than the United States was apparent. The Section has accordingly begun the preparation of a comprehensive report on the subject. It will be the special object of this report to suggest such opportunities as exist for extending our trade in the British market in competition with other countries that are now conducting a lucrative business there.

After the United Kingdom the most important foreign markets for our surplus farm products are afforded by Germany, France, the Netherlands, and Belgium. During 1901, Germany received 15 per cent of our exports, and France, the Netherlands, and Belgium together about the same amount. Each of these countries like the United Kingdom is at present importing extensively from other sources. They therefore offer similar opportunities for more active competition on the part of the United States. Reports on the agricultural imports of these countries have also been planned.

TRADE WITH DEPENDENCIES.

Special statistics have been compiled by the Section relative to our trade in farm products with the new insular dependencies, except

Hawaii, for which no separate returns are now made. Our agricultural exports to Cuba, Porto Rico, and the Philippine Islands in 1901 were valued at $18,600,000, comprising about 53 per cent of the domestic merchandise sent to those destinations. Compared with the trade for 1900, amounting to $17,551,000, the returns for 1901 exhibit a slight increase, gains in the exports to Porto Rico and the Philippines more than counterbalancing a considerable decline in the exports to Cuba.

As regards our agricultural imports from the three dependencies under consideration—Cuba, Porto Rico, and the Philippines—there was a decided increase, the value for 1901 amounting to $48,600,000, as compared with only $36,162,000 for 1900. The bulk of the gain occurred in the imports from Cuba, but there was also a noticeable increase in the case of Porto Rico. The imports from the Philippines showed a decline.

TRADE OF PACIFIC PORTS.

During the year the Chief of the Section of Foreign Markets was detailed to accompany the Congressional Committee on Rivers and Harbors upon its tour of inspection to the ports and waterways of the Pacific coast. The trip afforded an excellent opportunity to study the growing export trade that is being conducted through our Pacific ports, and much valuable statistical information was gathered on the subject. Of the $70,000,000 worth of domestic merchandise exported from the Pacific coast during the fiscal year 1900, $45,000,000 worth, or considerably more than half, consisted of farm produce. Indications point to a still further increase during the immediate future, the opening of new markets in the Orient and the rapid development of the wonderful agricultural resources of the Pacific coast region combining to render this branch of our commerce one of the most promising.

LIBRARY.

ACCESSIONS TO THE LIBRARY.

During the past year the accessions to the Library have numbered over 4,000 books and pamphlets. These accessions included many reference books of especial value in the work of the Department and a large number of scientific periodicals. The latter class of publications, obtained by purchase and by exchange, forms the most considerable, as well as the most valuable, part of the annual accessions.

CATALOGUE.

In addition to the regular work on the general card catalogue, a "Catalogue of periodicals and other serial publications" contained in

the Department Library has been completed and will be issued at an early date. Two reference lists, one containing references to publications on irrigation and land drainage and the other on tobacco, have been prepared, but a lack of funds for printing delays their publication as Library bulletins. It is to be regretted that the printing appropriation has not been sufficient also to provide for an increased number of issues of the card index to the Department publications. This index has increased the usefulness of these documents many fold.

DEMANDS UPON THE LIBRARY.

The constantly broadening fields of investigation being entered upon by the Department increase greatly the demands upon the Library. These investigations depend largely upon the extent of the Library's resources and their availability. To further these conditions adequate appropriations are needed, both for books and for their care and preservation. The amount of reference work done in the Library has increased so much during the past year that an assistant for this special work is much needed.

ASSISTANCE TO AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

In not a few cases college and station workers have drawn upon the resources of the Library to assist in some special work. Whenever it can be done without interference with the work of the Department, the usefulness of this large collection of books and pamphlets, many of which are not to be found elsewhere in this country, should be thus extended. This Library may justly claim to be the headquarters for agricultural literature, and as such should be able and ready to meet the demands from without as well as from within the Department. The requests which come from colleges and station libraries for suggestions as to the best arrangement of their material and as to other details of administration should be met with a ready response.

NEED OF MORE SUITABLE ACCOMMODATIONS.

The present Library room is entirely inadequate for the accommodation of readers and for the work of the Library staff. Much space is occupied for other than library purposes on account of the generally crowded condition of the Department offices. In addition to the necessity for more commodious accommodations for the present collection of over 70,000 books and pamphlets, there is the still greater need of a safer building than the one in which the Library now is. The destruction of any considerable part of this valuable collection of books would be an inestimable loss to the Department in particular and to scientists at large.

DIVISION OF ACCOUNTS AND DISBURSEMENTS.

Congress appropriated $3,303,500 for the United States Department of Agriculture for the fiscal year ended June 30, 1901, being an increase of $558,920 over the appropriation for the preceding year. When all accounts shall have been finally settled the payments will amount to about $3,220,000.

The regular appropriation of $15,000 for each of the 48 agricultural experiment stations in the several States was also made.

On June 30, 1901, the unexpended balances of the appropriations for the year 1899, amounting to $28,899.27, were covered into the Treasury.

During the year $6,340 was paid for rental of leased buildings in Washington. Owing to inadequate accommodations Congress, at its last session, provided for the lease of additional buildings, and the rental for the fiscal year 1902 will exceed $10,000.

BIOLOGICAL SURVEY.

The Biological Survey is engaged in mapping the boundaries of the natural crop belts of the country and aims to furnish the American farmer with lists of agricultural products which, so far as climatic conditions go, are likely to be a commercial success in different parts of the country. This work is based on the theory, the correctness of which is believed to have been established by the Biological Survey, that the boundaries set by nature to areas inhabited by particular kinds of native animals and plants are likewise the boundaries of areas in which particular agricultural crops may be most successfully cultivated.

LIFE ZONES AND CROP BELTS IN TEXAS AND CALIFORNIA.

During the past season the work of mapping the life zones and crop belts in the West has been continued, particularly in Texas and California. In Texas the boundaries of the several belts have been in the main determined, and it has been ascertained that over a large part of the arid lower Sonoran zone a fiber plant, a species of agave closely related to the Mexican istle or "Tampico hemp," grows in great abundance, covering an area about 20,000 square miles in extent. In view of the enormous quantity of fiber of other species of agave annually imported into the United States, mainly from Mexico, amounting in 1900 to 82,669 tons, worth $12,257,353, the Texas species is likely to prove of considerable commercial value.

In locating the boundaries of the zones in California many interesting facts have been brought to light. In this State, owing to the trend of the mountains and the influence of the coast fogs, the zones run in the

main north and south instead of east and west; and, except in the coast region and the northern part of the State, all but one are pushed up into the mountains. The valleys of the coast ranges, in retreating from the sea toward the interior, receive less and less fog and more and more heat and sunshine, affording in their individual climatic peculiarities conditions favorable for the growth of widely different agricultural and horticultural crops. Thus, while some are cool enough for apples, cherries, and the sugar beet, others are warm enough for almonds, citrus fruits, and raisin grapes. The hottest parts of the State, as well known, lie in the deserts east of the mountains, where, through the instrumentality of this Department, the date palm seems destined to become an important and profitable crop.

DESTRUCTION OF PRAIRIE DOGS.

On our great plains, which stretch from Montana and the Dakotas southward far into Texas, one of the chief enemies to agriculture and stock raising is a large ground squirrel known as the prairie dog. This animal appears to be increasing rapidly, owing to the destruction of its natural enemies, chiefly coyotes, badgers, ferrets, hawks, owls, and eagles. It is destructive not only to grain, alfalfa, and other cultivated crops, but also to the native bunch grass; and ranchmen complain that on certain grazing lands over which its colonies have spread during the past few years its mounds are so numerous and its consumption of herbage is so great that only half as many cattle can be pastured as formerly. In response to persistent complaints and urgent requests for remedies, the Biological Survey has prepared and distributed a circular of directions for the destruction of prairie dogs, and is now conducting field experiments in the Dakotas, Nebraska, Kansas, and Texas with a view to the discovery of remedial measures cheap enough for general use on the ranch lands of the plains.

SOME USEFUL AND NOXIOUS BIRDS.

In southern California it has been discovered that two species of birds, the Bullock oriole and the California least tit, feed extensively on the destructive olive scale, an insect injurious to both olive and orange trees, and that the common Western goldfinch feeds on green plant lice. On the other hand, some birds, particularly the house finch or "linnet," are bitterly complained of as enemies of the fruit grower. The relations of birds to fruit culture in California are so important that the assistant in charge of this subject was sent to the principal fruit-growing areas of the State, where important investigations were made, the results of which are now being prepared for publication.

In Texas it has been found that the large blackbirds, locally known

as "jackdaws," which have been slaughtered in great numbers for the millinery trade, are particularly valuable in the rice fields and cabbage growing districts, feeding extensively on the crayfish, which cut the rice, and on the destructive cabbage worm. In other investigations of the food habits of birds special attention has been given the thrushes, titmice, sparrows, orioles, woodpeckers, flycatchers, and swallows. The growing interest in economic ornithology is shown by the rapidly increasing demand for literature on this subject, to partly meet which a number of bulletins on food habits of birds have been published and distributed. The edition of one of these, entitled "Some common birds in relation to agriculture," has already reached 220,000 copies.

WORK UNDER THE LACEY ACT.

In addition to its other duties the Biological Survey is charged with general supervision of matters relating to game protection and introduction. It publishes bulletins on this subject and on laws governing the transportation and sale of game, digests of State game laws, and so on, and aids in every way possible the preservation of native birds and game. In carrying out the provisions of the Lacey Act the Department has received the active cooperation of three other Executive Departments—Treasury, Interior, and Justice; of several railroad and express companies; and of many State officials and individuals. A system of permits for the importation of foreign wild animals and birds has been successfully put into operation, and provision made for inspection at six of the most important ports of entry. During the year the number of permits issued was 186, covering the entry of about 350 mammals and nearly 10,000 birds. In order to avoid undue annoyance to importers I have extended the list of species which can be imported without permits to include a number of well-known animals intended for exhibition purposes. It is gratifying to state that the law has accomplished its main purpose in preventing the introduction of the mongoose and other injurious species, and has also brought to light several facts of interest. A considerable trade in live pheasants is carried on with Canada; thousands of Chinese quail are imported alive at San Francisco; and cage birds of many species are imported from Germany, China, Japan, Australia, and Mexico. The danger of introducing injurious species is very great, since several thousand birds are frequently imported in a single consignment; protection lies in careful inspection at the port of entry. During the coming year the inspection service will not only be improved but will be extended to Hawaii. Provision should be made for placing this service on a permanent basis and for maintaining it in the most efficient manner.

INTERSTATE COMMERCE IN GAME.

Numerous violations of the law regulating interstate commerce in game have been reported, and in many instances the Department has

been called upon to assist in prosecuting the offenders. Fifty-seven cases have been investigated, of which 27 have been referred for action to the Department of Justice, but whenever possible the evidence has been placed in the hands of State authorities. For the first time in the history of game protection it has been possible to secure convictions in cases involving illegal shipment of game months after the offenses were committed, and with evidence obtained a thousand miles or more from the point of shipment.

NEED OF MORE LIBERAL APPROPRIATION.

Again it seems necessary to call attention to the insufficient appropriation by reason of which the Biological Survey is obliged to carry on its field work in a piecemeal way, doing a little each season and returning the next year to the same region. The work could be done for considerably less money if the survey of a particular area could be completed at one time. A special effort has been made to carry the prairie dog investigation to a successful conclusion, but this requires field work on the Great Plains in the early spring, for which no funds are available. Owing to the same cause the Biological Survey has been forced to decline requests from several States for cooperation in carrying on local biological surveys. Such cooperative surveys would hasten the completion of the zone and crop maps, and would be of material service both to the States interested and to the General Government.

DIVISION OF STATISTICS.

With a smaller appropriation available for its work than was expended for a like purpose in any fiscal year from 1891 to 1898, inclusive, the Division of Statistics has endeavored to meet the ever-growing demand for statistics of the agricultural industry. It handled during the fiscal year nearly 2,500,000 returns from a corps of correspondents numbering about 250,000, the results of its work appearing in 18 separate reports, of which over 1,500,000 copies were printed.

While its work has consisted largely, as heretofore, of the preparation of reports relative to the principal products of the soil, including the extent and geographical distribution of the area of production, the condition and prospects of the crop during the growing season, and the quantity, quality, and disposition of the product harvested, it has also included reports on other branches of rural economics, such as the cost of transportation, the prices of agricultural products, the wages of farm labor, and the extent to which the principle of cooperation has been applied to different branches of the agricultural industry.

There is an urgent demand from many different directions for a substantial broadening of the scope of the work of this Division. Only the insufficiency of the appropriation prevents the live stock and live-stock products of the country—an interest so enormous that after

satisfying the needs of our own large population there was available last year for export over $250,000,000 worth of its products—from being reported upon as promptly and fully as are the cotton, corn, and wheat crops of the country. The annual fruit crop, the egg and poultry industry, beet sugar, flaxseed, and other products of great and growing importance also claim attention. The Department has already in operation all the agencies necessary to the collection, as often as may be necessary, of the required information relative to these important interests, and all that remains to be done is to provide the means for the employment of such additional experts and statistical compilers as may be necessary to the prompt compilation and analysis of so large an amount of additional statistical data.

Negotiations with the Governments of the principal grain-producing countries of Europe looking to a telegraphic interchange of crop reports are far advanced, and the growing season of 1902 will see the American farmer placed in as prompt possession of reliable statistics concerning the principal grain crops of foreign countries as he is of those of the United States.

For several years past determined efforts have been made, with the cooperation of the Public Printer, to expedite the publication and distribution of the Statistician's crop reports, so that as little time as possible might intervene between the issue of the telegraphic summary, the circulation of which is necessarily chiefly commercial, and the receipt in the most remote agricultural county of the complete report. On May 31, 1901, however, at a time when the keenest interest was prevailing throughout the entire South as to the extent of the newly planted acreage of cotton, a card containing the most important points of the Statistician's report on the subject was mailed to 24,000 Southern post offices within three hours of the publication of the telegraphic summary, with a request that postmasters would give it prominent display in their offices. This was done largely as an experiment, and so successful was it that within a few weeks its operation was extended with the most gratifying results to the grain reports. A farmer has now only to visit the nearest post-office to see the Statistician's latest report on the principal crops, and the measures adopted by the Public Printer and Postmaster-General have reduced to a minimum the time necessary to placing this important information within the farmer's immediate reach.

The remarkable accuracy of the Statistician's advance estimates of the cotton crop in each of the last two years has excited much favorable comment both in the United States and abroad, and his work in general is commended to Congress as worthy of largely increased provision for its further extension and improvement. This Division is growing in usefulness and in the estimation of the people. It is outgrowing its present environment and it will be wise in the near future to give it bureau enlargement.

SALARIES INADEQUATE.

During the remarkable developments in the agriculture and commerce of this country within the past fifteen or twenty years, the Department of Agriculture has steadily improved its personnel, has broadened its work along economic lines, and has contributed not a little to the progress of events and to the building up of domestic and foreign trade. Originally organized as a scientific bureau for acquiring and disseminating among the people useful information, it has solved many problems in animal industry concerning the cause and remedy of disease, has stamped out contagious diseases which threatened to ravage the country, and has kept open foreign markets by its system of rigid and competent inspection; through the Weather Bureau it has aided in saving growing crops and the products of the farm in transit, besides being of inestimable value in its warnings for the benefit of commerce in lake and ocean navigation. It has investigated the proper methods of controlling plant diseases and insect pests. It has studied and classified soils, pointing out their necessities and their values for certain crops, and has introduced new crops and new industries from abroad.

The Department has endeavored to retain the best scientific talent in the country for the investigation of the many problems confronting the agriculturist, in the interest not of pure science but of agricultural and commercial development. Coincident with the growth in the Department's duties, and largely as an outcome of it, numerous institutions have grown up in every State of this country, as well as in foreign lands, devoted to lines of work similar to those pursued in the Department, which may be generally described as the application of science to the service of agriculture. These State and governmental institutions, and the private agricultural interests as well, are now paying salaries for expert services commensurate with those paid in professional and industrial lines. Men with good business training and thorough understanding of agriculture and a fair knowledge of scientific principles and methods are constantly in demand at good prices.

There has never been in the history of the world such a strenuous competition between the different countries for commercial supremacy as exists to-day. Each nation is exerting itself to the utmost to extend its production, so as to supply its own wants and to provide a surplus for exportation. In doing this they are depending more and more upon the aid of science, and are taking advantage of every scientific discovery. The result is that men who combine knowledge with experience and practical ability are difficult to get and are increasingly in demand. In the general conflict between nations it is obvious that that country which has been the most liberal in securing properly equipped organizers of its industry is sure to have the advantage in this commercial strife.

Yet the Department of Agriculture of this country has frequently had to record the loss of men trained in its services, who have been called away to other fields by offers of more generous remuneration. The danger of losing good men has never been so great as at the present time. Last year a foreign government secured one of our tobacco experts at a salary four times what this Department was giving him, and quite recently the papers have announced that the result of investigations made under his auspices are so promising that it is believed the demand for American and other imported tobaccos in that market can be stopped and the requirements supplied by home production. Subsequently an offer was made to another tobacco expert in the employ of this Department at a salary of about three times what he was being paid. This had to be met by an increase in his salary, amounting to one-third more than the chief of the division who was directing the work was allowed by statutory enactment. As an executive act, this was not good policy nor compatible with the best interests of the Department, but the work in hand had to be provided for, pending further action by Congress.

More recently still, advances have been made by several foreign governments to secure the services of some of the leading men of the Department, the chiefs of Bureaus, offering such liberal increases over the salaries paid here that it becomes almost a matter of duty on the part of the men to accept. Such acceptances, if carried out, would not only cost the Department some of its leading men, but would also draw away many of their subordinates who are now in excellent training for valuable work.

It is apparent in reviewing the work of the past fiscal year that the men who have planned and executed the investigations which have been carried on have earned for the country many times over the cost of their salaries and the money appropriated for their use. It is an axiom among business men that the more expensive employees are often the cheapest, by reason of their being most productive. The Department has always been obliged to train its own men, and has only too frequently lost their services when, from their ability to handle large questions, they have been called elsewhere at more remunerative salaries. The Department should not always be in this position of having to train its men in order to get them cheaply, but should be allowed to secure the services of capable men already trained by giving salaries commensurate with the valuable commercial interests to be put in their charge. The loss of time necessary to train men to handle these problems is in itself a serious drawback, and if they are called elsewhere after receiving their training and before they give valuable returns to the Department in the way of productive work, the time and money spent upon their training is largely thrown away.

In view of these facts, I have provided in my estimates for a salary

of $5,000 for the chiefs of the Bureaus in this Department, firmly believing that the men who now occupy these positions are fully deserving of such salaries; that if less is given them they will be called to other countries or to other positions in this country, and that if these men, who have been instrumental in the remarkable development in the work of the Department in recent years, sever their connection with the institution it will be impossible to fill their positions with capable men for anything less than the salaries named. I would urge upon Congress in the strongest terms liberality in this regard, as I believe it to be for the best interests of the country to obtain and retain the best men that can be found for these important positions; and I would also urge this increase in their salaries in order that we may appoint experts at salaries which they can command in commercial lines, and not have to take the humiliating step of paying the experts more than the chief of the bureau who is directing the work, a step which has had to be taken twice already in one of the Bureaus of this Department, in order to secure from the commercial world men competent to maintain the integrity and insure the success of the work that had been undertaken.

The chiefs must direct the special technical education of the students in their lines. If we could look to the universities and colleges of the country for men prepared to do our work in applied sciences relating to agriculture, the loss of an expert chief would not be so serious. From the agricultural colleges we are getting young men and women as scientific aids, who will become valuable investigators and teachers in their specialties after being trained in the Department, but the chiefs who train them are indispensable at present.

Respectfully submitted.

JAMES WILSON,
Secretary.

WASHINGTON, D. C., *November 23, 1901.*

THE PURPOSE OF A SOIL SURVEY.

By Milton Whitney,
Chief of the Bureau of Soils.

INTRODUCTION.

SOIL SURVEY BASIS FOR IMPROVED AND INTENSIVE CULTIVATION.

At the close of the calendar year 1901 the Bureau of Soils had surveyed and mapped an area of 15,872 square miles, or 10,158,646 acres, of land in 21 States and Territories. This bare statement of fact carries with it no idea of the great variety of soil types that have been identified, the experience that has been gained by the soil survey parties in spending from two to eight months in a locality, nor of the many problems encountered in the selection of suitable crops and methods of cultivation for the different soils. In this field of research that has been developed in the Department of Agriculture there is the basis for improved and intensive cultivation, and information is being acquired of the possibilities of developing industries and improving conditions which is to be an important factor in the agricultural progress of the country.

KNOWLEDGE OF CONDITIONS NECESSARY FOR AGRICULTURAL SUCCESS.

There has never been a time in the history of the world when the different nations and communities have contended so strenuously for commercial supremacy, even for commercial existence, as they do to-day, when the markets of the world are brought close together by the enormously improved transportation facilities of recent years. The operation of the ordinary laws of trade and the relatively low transportation rates which prevail over the railroad and steamship lines have effected such economic changes as to render overproduction almost impossible. It is true that occasionally there will be an overproduction of certain articles, due to unusually favorable climatic conditions or to overconfidence of the people as to the future prices of the commodity; so occasionally there is a local shortage of production, due to unfavorable climatic or commercial conditions, and then potatoes and cabbages, for instance, may be sent with profit to America from Scotland, Ireland, Holland, and Denmark, as has been done this year, or foodstuffs may be sent from this country to the Orient to supply a local deficiency in that quarter.

Apart from these local or seasonal variations, there are in many

localities controlling factors that favor large yields or superior quality, or cheap production of certain articles against which it is difficult to compete in other less favored localities; and industries in such less favored localities are slowly built up and commercial success is only to be attained by the most careful methods and the most intelligent use of all natural advantages.

Individual effort, enthusiasm, training, and knowledge play as large a part in the successful management of agricultural affairs as in any other line of business. There are probably fewer notable successes in agriculture than in manufactures or trade, but this is because of the more complex nature of the problems—the uncertainty of the climatic conditions, not only in the immediate locality where the operations are being conducted, but in other parts of the world where the same commodities are being produced, the length of time required to mature and manipulate the crops, and the extreme difficulty on the part of growers of determining what are the real market demands. It takes more courage and keenness of perception to make a great success in agriculture than in most of the commercial industries. Given a tract of a thousand acres of land in any part of the country, even with unlimited capital for its cultivation, and, except in a very few localities, it requires rare business ability and judgment to make an unqualified commercial success in agricultural pursuits. Yet, there is hardly a portion of the United States at present in which there are not highly successful agricultural enterprises being carried on in which men of ability can command excellent salaries or make for themselves comfortable incomes. In the truck interests, the fruit interests, and the dairy and cattle interests salaries ranging from $5,000 to $6,000 to competent managers of estates are not uncommon, and incomes exceeding these by considerable amounts are frequently enjoyed by men who manage their own lands.

The majority of farmers are not so successful; neither are the majority of business men. The absolute failures in the business world are probably far more numerous than those in agricultural lines. If the worst comes to the farmer, retrenchments can always be made in agricultural pursuits, and a bare subsistence can always be had by a moderate expenditure of money and of labor. The land will at least feed the family, even if it does not clothe and educate them and give them the social advantages they would wish. This is not always so by any means with the business man, and often he has to give up the independent control of affairs and seek employment with others who have a better business capacity.

POSSIBILITIES OF UNPRODUCTIVE AREAS.

There are many areas of our own country in which the soils are too poor or are in such wretched condition that they can not be profitably

farmed to our ordinary crops, and these areas are awaiting special industries or different methods of cultivation. Examples of this kind are numerous. The truck interests have been developed upon a class of soils along the Atlantic seaboard which thirty years ago had merely a nominal value. The pineapple industry of Florida has been developed on what appears to be an absolutely barren quartz sand. The grape and fruit interests now occupy many rough, stony, and mountainous areas that formerly had no more value than the market price of the timber they supported. The development of the arid West through irrigation and the specialization of crops is too well known to require more than passing notice. The introduction of Kiushu rice has enormously increased the value of large tracts of former waste areas of Louisiana and Texas. The introduction of Sumatra tobacco in the Connecticut Valley has augmented the value of the light sandy lands at least 200 or 300 per cent. The introduction of a desirable filler leaf is confidently expected to increase in much the same ratio the price of land in localities where it can be grown. The extension of the fruit orchards on the slopes of the Blue Ridge and Alleghenies is giving a fair commercial value to lands which were formerly almost worthless. What may be done with the vast areas of our Coast and Gulf States, which have been worn out by the exclusive cultivation of cotton or the superficial methods employed, or which have always been unproductive, is a great problem for the future to solve. That some use shall be made of them, that some crop shall be found adapted to them, there is no reason to doubt.

The commercial supremacy of America can have no safer basis than agricultural independence, and with the fierce competition of the present day it is essential that advantage be taken of every natural condition and of the most accurate scientific knowledge. Chief among these natural conditions are the soil and climatic conditions, for it is upon these mainly that agriculture depends. It is for this reason that the soil survey is bound to take a prominent part in the development of this country, serving as a basis for the introduction of new crops imported from other countries, the creation of new industries, and the improvement of the agricultural methods already in use.

THE OLDER METHODS OF SOIL INVESTIGATIONS NOT SATISFACTORY.

For sixty or seventy years agricultural chemists and physicists have tried to work out the basis of the fertility of soils and a practical method of soil classification. The soil is in itself a very complex material, and added to this the constant changes of climatic conditions, the constant factor of weathering influences, and the extremely complicated physiological functions of the plant have made a problem too difficult for solution. Chemical methods are not sufficiently refined,

and the physical problems are too numerous and involved for the scientist to explain satisfactorily even the simplest relation of the soil to the plant. Advances have been made both in chemical and physical lines, and our knowledge of soil phenomena has been greatly extended, but the basis of the relation of soil to plant production is still seemingly far from a satisfactory solution.

While this is so, it has been found possible to use certain methods, both physical and chemical, added to the observation of trained experts in the field, in making a practical classification of soils—a classification based not only upon texture and composition, but upon vegetation as well, which makes it possible to predict safely the extension of industries from one area to another possessing the same character of soil. Thus, while it is impossible to advise definitely from a chemical analysis of a sample of soil sent in to the laboratory as to the kind of crop it will produce or as to the fertilizer requirements, yet as a result of a soil survey it can be determined what new crops can be introduced and what methods are necessary to accomplish desired results.

The soil survey has been developed within the last five or six years by the Bureau (formerly the Division) of Soils, and so much of positive good has resulted that in spite of the liberality of Congress the demands for extension of the survey are far greater than the Department has been able to satisfy.

METHODS OF THE SOIL SURVEY.

THE SURVEY PARTY AND COST OF WORK.

When an area has been selected, a party of from two to four men is sent out and remains in the area from two to eight months, according to the size of the district, the reliability of the maps, the character of the country, the condition of the roads, and the complexity of the soil types. The average rate at which the work has been done heretofore is about 4 square miles per day, or 100 square miles per month (for a party of two men), varying greatly, however, with the conditions, as stated above. The average cost of the work has been $2 a square mile for the survey alone, or $3.50 including the preparation of reports and maps and the salaries of men during the winter, when the field operations can not be carried on. This amounts to about 56 cents per 100 acres.

RELIABLE BASE MAP ESSENTIAL FOR SURVEY WORK.

The first essential for the survey is a reliable base map; if possible, on a scale of 1 inch to the mile, which is the scale of the soil map. This base map should show all the roads, with every turn and angle accurately reproduced, the streams and towns properly located, and, if possible, most of the houses and also contour lines indicating the elevation and position of hills, plains, and valleys. This detail is necessary

in order that the soil experts may constantly know where they are, so that they may draw their boundary lines between the soil types with exactness. In Western areas, where the lands are reasonably level, where the roads follow section lines, and the country is unwooded, the absence of a suitable base map is not a matter of much moment, as a traverse map may be constructed by the soil-survey party almost as rapidly as the soil work progresses. In hilly or wooded areas, however, the absence of a base map necessitates an actual survey of the area, and this is not considered a proper function of the Bureau of Soils.

Wherever possible the topographic sheets of the United States Geological Survey are used, as these indicate accurately the streams and roads, the contour lines, and frequently the houses. In areas where the Geological Survey has done no work reliable county maps may be used, as they are often found to be satisfactory. Where there are neither Geological Survey sheets nor accurate county maps it is almost impossible to carry on the soil survey except through the cooperation of State institutions which will undertake to make a traverse map. Such cooperation has been secured in at least one instance, and the results have been extremely satisfactory. A satisfactory traverse map was made for the Bureau by the North Carolina department of agriculture of the area from Raleigh to Newbern, showing the streams, roads, and houses, embracing 1,000 square miles, at a cost of about $1,000, or at the rate of $1 per square mile.

EQUIPMENT OF THE SURVEY PARTY.

Having secured a base map, the party is provided with a horse and buggy for each two men, and supplied with a compass, an odometer for measuring distances, occasionally with a plane table to survey new roads, and with a soil auger, used to take samples to a depth of 3 feet in the Eastern States and 6 feet in the Western, and with additional lengths of pipe for occasional borings of 15 or 18 feet. Parties in the West, where alkali is likely to be encountered, are equipped with a trunkful of instruments for determining the total salt content of the soil down to a depth of 6 feet or more, and with an outfit for determining in the field the chemical composition of the alkali salts and of the irrigation waters.

It is a great advantage in the development of the work to have a thorough knowledge of the geology of the region; not that this is in itself a basis for soil mapping, but the character of the soil and its distribution is largely influenced in any region by its geology. The physiography or form of the country must also be studied, as this determines to a large extent the distribution of the soils.

SOIL-SURVEY WORK IN THE FIELD.

As an illustration of the way the soil-survey work is carried on, it may be supposed that a party starts out on a straight road 4 miles or

more in length. As they drive along the road one or both of the men go out on either side into the fields for a distance of half a mile, more or less, or halfway across to the next road, according to the character of the country and the position of other roads, and take frequent borings, examining the material carefully, noting the texture, whether sand, silt, or clay, the changes which take place at varying depths, the presence of gravel, the drainage conditions, and the character of the crops or native vegetation. If the boring shows a sandy loam to a depth of 6 or 8 inches and below this a loam grading into a clay at a depth of 24 to 30 inches, the soil will probably be called a sandy loam or a loam, according to the general character of the material as a whole. If these conditions are found to prevail over a considerable area this will be recognized as a soil type, and a local name will be adopted, so as to give it an identity. It may, for instance, be called Cecil sandy loam.

Moving forward with their work, if the party found that the material changed, either in the surface soil or in the subsoil, sufficiently to influence plant growth, the character of this change would be noted; and if it were of sufficient importance and covered an appreciable area, a new type would be established, designated by a different local name, and the characteristics of this soil would be described. The boundary between the two types would then be traced out, the character of the vegetation or crops and the physiography of the country frequently being an important aid in this work.

When the team has traveled 4 miles along the road and the men have worked out half a mile on either side, this constitutes an average day's work for two men, that is, an area of 4 square miles per day. If the soils are very complicated and the types occur in small areas, the progress is much slower; while if the types hold constant over a considerable area, more work can be accomplished. The next day a road parallel to the first road may be taken and the surveys connected.

The number of soil types in the areas that have been surveyed ranges from three to sixteen. In all of these there will be certain local variations, due to slight depressions or slopes or to methods of cultivation; but these variations are not recorded, and it has been found that the general types are quite persistent and the boundaries usually sharply defined. The smallest area which can be shown upon the map is 10 acres in a square tract, which covers an area one-eighth inch square on the map.

When the types have become well established in the minds of the soil experts a description of them is sent in to the Bureau, and this must be so clearly stated that the reason for establishing each type is plainly apparent; otherwise the matter is referred again to the party for more complete information or for possible merging into other types in the same or in other areas.

Separate samples of the soil and of the subsoil are sent in to the laboratory from a number of borings in each of the soil types, the number depending upon the extent and importance of the area or the agricultural problems presented therein. These samples are examined in the laboratory, a mechanical analysis is made to show the grade of material composing the soil, and such chemical work is done as experience may indicate will be of probable value in understanding the conditions encountered in the area.

During the months that the party is in the field they are careful to observe the character and yield of the crops. They are instructed to obtain all possible information from the farmers as to the methods of cultivation, the relation of the soils to drought and to drainage, and in general to acquire all knowledge possible in regard to the conditions existing in the area. As they become more experienced they are able to advise in their reports upon many practical questions and to judge by comparison with other districts which they have surveyed whether there is an opportunity of introducing new crops or improved methods of cultivation.

The party makes its temporary headquarters in one place for a week or two, sometimes extending this to a longer period and sometimes staying but a few days, according to the condition of the country as regards its roads and the possibility of obtaining accommodations near their field of work.

REQUIREMENTS OF THE BUREAU REGARDING SOIL MAPS AND REPORTS.

It is a requirement of the Bureau that the soil maps must be constructed in the field and must be completed in every detail before the party leaves the area. It is also urged that every party shall prepare at least the first draft of the report to accompany the map before they leave the area. If possible, the report must be completed in all details. In preparing their reports the parties are guided by a general schedule showing the subjects that must be treated and the order in which they should be taken up. The approximate space to be devoted to each subject is given as a guide, but this may be varied according to the necessities of the case. The subjects given for the report are: Location and boundary of the area; geology, physiography, and climate; history of the development of agricultural interests; description of each soil type; any special problems presented in the area; and a brief description of the conditions of agriculture. In the Western areas the subject of alkali, the improvement of alkali lands, drainage conditions and possibilities, and methods of irrigation are also included.

Owing to the number of field parties and the number of areas that are surveyed each year, in order to limit the size of the annual publication the reports on each area are limited as nearly as may be to 20

pages for the Eastern parties and 30 pages for the Western; yet even with this restriction the report on the soil survey for 1901 will exceed 600 pages.

The reports are required to be of a simple, practical nature, which can be read and understood by the large number of persons to whom the publications are distributed. Congress provides for an edition of 17,000 copies, and the report is sent to all classes of people; it is intended particularly to benefit farmers, to let them know what their soil conditions are, but it is also for the information of prospective purchasers and settlers.

DEVELOPMENT OF THE SOIL SURVEY.

The line of soil investigations which gradually developed into the present method of the survey was started for the purpose of tracing the relation between the soils and special crops (such as wheat, corn, grass, and truck) in the Atlantic coast States. The first specific authorization for a soil survey was made by Congress for the purpose of mapping the tobacco lands of the United States, and it was on this authorization that the work was started in the Connecticut Valley. Up to the present time this valley from Hartford, Conn., to some distance above Springfield, Mass., has been surveyed, and the relation of the various soils to tobacco and to other crops has been determined and described in a report.

SOIL-SURVEY WORK IN TOBACCO REGIONS.

Two seasons have been spent in the Lancaster and Lebanon Valley areas of Pennsylvania, the heart of the tobacco region of that State, and maps have been prepared covering nearly a thousand square miles.

The soil survey in Connecticut led to the successful attempt at the introduction of Sumatra tobacco on certain soils of the valley; while the work in Pennsylvania showed that the soils there are very different from those of Connecticut, and are adapted to the filler type of tobacco. The present grade of tobacco raised in the Pennsylvania area sells for about 7½ cents a pound; the Zimmer Spanish, grown in Ohio, brings from 12 to 15 cents; while the Cuban filler imported into this country is worth from $1 to $1.20 a pound. This indicates the great difference in the quality of the leaf grown in this country and in Cuba. There is no question that the Cuban tobacco is and has always been a standard of excellence, and the Pennsylvania leaf can hardly be classed as a competitor. In other words, the market requires a different style and quality of leaf from that now produced in Pennsylvania, and the problem presented by the soil survey was: Are there soils in Pennsylvania and are there indications in the quality of the present crop which would offer reasonable assurance that a product could be grown approaching more nearly the ideal type from Cuba?

In the Lancaster area there are two types of tobacco soil which are important, two upon which tobacco is only occasionally grown, and one (lying adjacent to the Susquehanna River and occurring in a very narrow belt) which is adapted to a fine grade of wrapper. The tobacco experts of the Department believe that there is reasonable prospect of raising a much finer grade of filler leaf on some of these soils. Whether it will equal the average Cuban leaf is a question. It will certainly be better than the lowest grade of Cuban tobacco (grown at the eastern end of the island), which is not imported into this country at all, most of it being sent to Germany; and how near the product can be brought to the best Cuban leaf is of course a matter impossible to predict.

During the summer of 1900 a soil survey was made of the whole of Montgomery County, Ohio, the center of the Zimmer Spanish district of the Miami Valley. This district furnishes what is held to be the finest grade of filler in this country, at least before the introduction of the Cuban crop of Florida three or four years ago. There are fewer soils here to experiment upon, but the character of the Zimmer Spanish tobacco more nearly approaches that of the Cuban leaf than does the Pennsylvania product, and there is reasonable hope of improving the Ohio crop.

A soil survey was made during the summer of 1901 in a portion of Montgomery County, Tex., as tobacco had been grown there for several years, some part of which possessed admirable quality, occasional leaves having the most desirable characteristics of the Cuban leaf. The crop as a whole, however, did not maintain this high degree of excellence, and in the last year or two the industry has been almost abandoned. This failure is believed to be due to a number of causes, chief among which is the fact that the product has not been handled as it should have been. The indications of good quality furnished by portions of the crop warrant a thorough investigation of the possibility of raising Cuban filler in that locality.

Cigar leaf of promising character from portions of California has also been examined by the Department experts. Here again the handling of the crop has been unskillful, and the product as a whole is not particularly good, but there is sufficient promise to warrant the belief that a desirable leaf can be grown on certain soils in that State. Large areas have been surveyed in California, and the soil maps which have been constructed will serve as a basis for future tobacco investigations.

During the summer of 1900 and again in 1901 extensive soil surveys were made in North Carolina in the bright-tobacco belt and in the manufacturing tobacco districts of Virginia.

In 1901 Montgomery County, Tenn., the center of the export tobacco region of that State, was surveyed as a preliminary to investigations

which will be taken up later, looking to the improvement of these heavy export types of leaf.

A large part of the present tobacco district in Maryland, embracing three counties in the southern part of the State, has been surveyed and the foundation laid for possible improvement in the type of tobacco produced—a type which has so long held its own as a light, free-burning smoking tobacco, but which is now being crowded out by the Burley of Kentucky on account of the adaptability of the latter to other uses which the Maryland leaf can not successfully fill.

EXTENSION OF THE SOIL SURVEY TO GENERAL CROPS.

In March, 1900, Congress specifically provided for a much wider scope of the tobacco investigations and authorized in general terms the mapping of the soils of the United States. It has never been the intention of the Department, and was probably not intended by Congress, that any systematic plan should be adopted of preparing soil maps of the entire country. On the contrary, it is the purpose of the Department to investigate and map the soils of certain agricultural districts which may be noted for the excellence of their products or which lack remunerative crops.

During the summer of 1901 soil surveys were made in different portions of the Piedmont Plateau, including areas in Maryland, Virginia, North Carolina, and Georgia. The mapping of the soils (having the same character, derived from the same class of rocks, occurring in this widely separated distribution under the range of climatic conditions that prevail within this distance of 900 miles) and the study of the methods and habits of the people have resulted in throwing new light upon the problems of agriculture in these several States.

During the summer of 1901 a survey was made in Virginia along the Blue Ridge Mountains, where the apple and peach industries are developing; and the relation of the soils to these crops was studied and valuable information acquired which will offer a basis for the more intelligent development of the industries. The demand for such work has been very great, and it is probable that the survey will be extended to other areas of this mountainous region in the interest of the fruit growers.

Many urgent requests have come to the Bureau of Soils for the extension of the soil survey into the rice lands of the coast regions of Louisiana and Texas. The introduction of the Kiushu rice by the Department, already mentioned, has built up an industry estimated to be worth $1,000,000 a year to the State of Texas alone. This industry is confined to the coast country, and it has been found that the types of soil have a considerable influence upon the yield of rice. One of the most prominent growers, a man who probably knows more about the

industry than anyone else, has stated that the yield of rice varies on the different soils from about 8 barrels to 20 barrels per acre. If these very productive soils can be outlined on maps, so that the main energies of the planters can be devoted to their cultivation and not to the less productive soils, great good will naturally accrue to the rice interests. During the fall of 1901 a beginning was made in the survey of about 260 square miles in the rice country between Lake Charles and Crowley, La. This work will probably be continued and extended into the rice belt of Texas.

During the summer of 1901 a soil survey was made of Allegan County, Mich., which lies in the center of the peach belt of that State. Sixteen types of soil were mapped in this area, and their relation to crops was studied and described in the report which will accompany the map when published. Some of these soils are adapted to peach culture, others to sugar beets, others to peppermint, and others to general farm crops. The adaptation of each type is pointed out in the report.

During the same time a soil survey was made in the center of the grape belt of Chautauqua County, N. Y., and the relation of the various soils to the grape industry and to general farming was pointed out.

One of the most interesting areas surveyed in the season of 1901 was one of about 600 square miles in the southwestern part of New Jersey, including some of the finest truck lands and general farming country of that State. The region was found to be in a very prosperous condition, and special attention had already been given by the farmers to the proper adaptation of the soils to different crops. An interesting feature of this work was that many of the soils were found to be identical with those of southern Maryland, where, through a lack of such adaptation of soils to crops, the communities are far less prosperous than those in New Jersey. The contrast and the remedy for the Maryland area are clearly shown in the report.

SOIL SURVEY FOR DEVELOPMENT OF A MISSISSIPPI AREA.

During the fall of 1901 a survey was made of an area in Mississippi extending from a point about 12 miles east of Yazoo City and taking in this breadth of upland, and from thence 30 miles across the Yazoo and Mississippi Delta to the Mississippi River. The upland soil was readily identified as a loess, and it has been confidently predicted that alfalfa could be introduced upon it and the cattle industry built up.

The delta proved one of the most interesting areas that has been surveyed. The cultivated soils of the delta region follow the rivers and bayous, having been built up from the annual overflow of the rivers. These soils have an average width rarely exceeding a mile on either

side of the streams. They are formed of the coarser fragments of silt and sand deposited by the waters, while the finer material has been carried farther inland and finally deposited by the quiet waters in the large areas known locally as "open swamps." These lands are not swamps in the ordinary sense of the term. They have no cypress, except in the occasional bayous or true swamp areas, but are covered with a dense growth of hard wood. They are overflowed every year, the water subsiding about the first of June and the lands becoming cultivable too late for any of the ordinary crops. Throughout the remainder of the year, however, the lands are dry.

The cultivated lands along the rivers have been built up somewhat higher than the open swamps and are only subject to occasional overflow in the very highest freshets, which occur once in twenty years or so. Three grades of soil are recognized in these areas—a sandy loam, which produces from one-half to three-fourths of a bale of cotton to the acre; a loam, producing from three-fourths to one bale; and a clay, producing from 1¼ to 1¾ bales. Of the entire area surveyed, about 10 per cent is covered with the sandy loam, 8 per cent with the loam, 16 per cent with the productive clay, and 65 per cent with the open swamp or "Sharkey clay," which is not cultivated. This Sharkey clay, composed of the very finest sediment of the rivers, is a stiff, tenacious clay, exceedingly fertile, as shown by the dense forest growth of hard woods, and the problem of cultivating this large area of what is at present waste land can be solved either by finding short-lived crops which can be planted after the floods subside and mature within the growing season, or by diking the lands off and preventing the annual overflow. This latter method appears to be a possible engineering feat which would not be particularly expensive, in comparison with the wonderful fertility of the lands and their probable high productiveness if protected by suitable dikes.

The sandy loam along the rivers is a fine type of early truck soil, and with the direct communication which is maintained with the Chicago markets, this industry could be profitably introduced. Truck crops with an intensive method of cultivation should yield ten times the profit on this soil that is now obtained from cotton. It is proposed to extend this Mississippi survey to include a much larger area, so that the possibilities of developing this important country may be more clearly seen.

VALUE OF THE SOIL SURVEY WORK.

No better illustration of the value and use of a soil survey can be given than in a brief description[1] of 16 types of soil in the area mapped between Raleigh and Newbern, N. C., in 1900. This area extends entirely across the coastal plains.

[1] Field Operations of the Division of Soils, 1900, pp. 36–39.

REPORT OF SURVEY OF AREA BETWEEN RALEIGH AND NEWBERN, NORTH CAROLINA.

The Cecil clay is the product of disintegration of the crystalline rocks of the Piedmont Plateau. The soil is a red clay, 6 inches deep, resting on a stiff, tenacious red clay. Both the soil and subsoil contain considerable quartz and rock fragments, sufficient to be very wearing upon implements. These fragments insure good drainage, however, especially as the broken quartz is arranged in perpendicular veins in the subsoil. The soil when well tilled makes the best wheat and grass land of the locality, and is also an excellent cotton and corn land. It is decidedly the strongest and best soil for general farming and stock raising in the area.

The Cecil sandy loam has the same origin as the Cecil clay, but differs from it in having from 6 to 10 inches of a brown sandy loam overlying the stiff red clay. Both soil and subsoil contain the same quartz and rock fragments as the Cecil clay. The red clay subsoil insures a uniform moisture content, and the land withstands drought well. The soil is adapted to cotton and grain, and some bright tobacco is raised on it.

The Durham sandy loam is closely related to the two preceding types, being composed of the same material, although partly of sedimentary origin. It has the same quartz and rock fragments, although the quartz veins do not occur in the subsoil, and the subsoil clay is of somewhat different character. The soil also contains more sand than the Cecil sandy loam. It is better adapted to corn, bright tobacco, and truck than to cotton or small grain. All three of these types are quite rolling or even hilly.

The Norfolk sandy soil is a coarse, sharp sand or sandy loam, 10 to 20 inches deep, resting on yellow clay. The surface is generally level. It is not adapted to small grain, is fairly well adapted to cotton, but is well suited to corn, bright tobacco, and truck.

The Norfolk fine sandy loam differs from the above only in the character of the soil. It consists of a fine-grained sandy loam, 10 to 15 inches deep, resting on a rather stiff yellow clay. The surface is generally level. It forms a large and important type in the area surveyed. The clay subsoil holds fertilizers and maintains moisture, so that the soil withstands droughts well. It is an excellent cotton soil, and is well adapted to corn, bright tobacco, and truck.

The Norfolk sand is the typical early truck soil of the area, as it is of the whole Atlantic coast. It is a deep, sandy soil, 3 to 6 feet or more in depth. It is generally loose and incoherent, and makes sandy roads. It is not well adapted to either cotton or corn, except under the intense cultivation and heavy fertilization given for truck. It is used almost exclusively for truck growing for the early markets, and is the more valuable the nearer the water, where protection from frosts is afforded and cheap transportation is possible.

The Goldsboro compact sandy loam consists of a sharp sand which compacts on drying, forming firm, hard roads, and requires constant cultivation, especially after rains, to prevent the formation of crusts. When allowed to dry without stirring, it is frequently difficult to plow, and is not in good condition for crops. In low-lying areas it frequently needs artificial drainage. There is little or no difference between the soil and subsoil. It is fairly well adapted to cotton and corn.

The Selma silt loam is a gray silt, 18 inches deep, overlying a mottled yellow clay subsoil containing some fine sand and small gravel. The surface is gently rolling and the drainage is good, except in a few low places. This is a fine cotton soil, and one of the most valuable soils for bright tobacco especially, as occasionally happens when the silt contains an admixture of fine sand, permitting more perfect drainage—a condition which renders the soil less fit for cotton.

The Selma heavy silt loam consists of a heavy, compact silt 10 to 20 inches deep, overlying a stiff mottled clay. It occurs generally in flat, level areas, poorly drained,

and generally requiring artificial drainage. When drained it is well suited to cotton, much better, in fact, than to any other crops of the locality. It is not at all suited to bright tobacco.

The sand hill soil is a coarse, loose, incoherent sand, 10 feet or more in depth, little adapted to any agricultural crop, owing to the small water-holding power of the soil. It occurs generally as low hills, and the sand is often from 20 to 60 feet deep. Recently peaches have been tried with some success. The fruit has a rich color. The soil is generally uncultivated, and supports a growth of scrub oak and pine.

The Neuse clay is a stiff, silty or fine sandy loam, 10 to 20 inches deep, underlaid by a stiff mottled-clay subsoil. It is generally subject to overflow in time of freshets, and is used mainly for pasture or left to forest growth. It is difficult to till in wet or in dry seasons, and is little esteemed for farm purposes.

The Garner stony loam consists of a sandy loam 6 to 15 inches deep, containing from 40 to 60 per cent of rock fragments and gravel, often of considerable size, underlaid by a stiff red brick clay. The soil packs firmly over the clay subsoil, affording firm roads almost equal to macadam. The surface is quite rolling, and this thin veneer extends over the whole area, rendering it exceedingly difficult to till and almost valueless for agricultural purposes. It supports a forest growth, however, containing good merchantable timber, principally pine.

The Susquehanna gravel is a very gravelly soil of small extent and of little agricultural value.

The Savanna is a physiographic type rather than a soil type. It is a low flat area with poor drainage. The country is often flooded for considerable periods from the ordinary rainfall of the locality. It is generally sparsely wooded, but supports an abundant growth of cane and coarse grass, which afford good pasturage. It can nearly always be drained, but on account of the level surface and broad extent this is a difficult and costly operation. When drained it is adapted to cotton and corn. It is, however, seldom cultivated.

The Pocoson is also a low-lying area, generally swampy, and having a black, spongy, mucky soil. It supports a sparse growth of scrub pine and a very thick growth of grass, bushes, and vines. In dry seasons it affords good grazing. In such seasons there is danger from fire, which burns not only the grass but also the mucky soil itself, ruining the pasturage for some time. When cleared and drained the land is excellent for cotton and corn, but only small areas have been so reclaimed.

A few areas of muck are found in the area surveyed, but these are usually of small extent, and make fertile corn lands when drained. Few areas of cypress swamp were encountered, and these were of small extent.

It is thus seen that, although a large number of soil types was encountered in the area, they all have quite distinctive characteristics, and are adapted to different interests or have different crop values and require different treatment.

SOIL WORK IN IRRIGATED REGIONS.

A large amount of work has been done in the irrigated regions of the West. These surveys have been made in the principal irrigated districts in New Mexico, Arizona, California, Utah, Idaho, and Washington. About 2,200,000 acres have been surveyed in irrigated areas, presenting a great variety of agricultural conditions. The fruit districts around Hanford and Fresno, Cal., have been studied, and the grain, fruit, and sugar-beet lands of Ventura and Monterey counties have been mapped. Three areas in southern California have been surveyed, one on the Coastal Plain around Santa Ana, and one in the

San Gabriel Valley, and the third in the untried desert lands lying east of the Colorado River. In Arizona the lands lying along the Colorado River and in the Salt River Valley have been mapped. In New Mexico, the Pecos Valley has been surveyed; in Utah a portion of the Jordan Valley near Salt Lake City, the Sevier Valley, and the country around Ogden. The surveys in Washington and Idaho were confined to the Yakima and Boise valleys. In some of these the work has been simply a soil survey; in others, where the alkali problem has been encountered, a thorough study has been made of the character of the salts, the extent to which they have injured or are likely to injure the lands, and consideration has been given to methods of reclamation and drainage.

In the Salt Lake district mapped it was found that about one-fifth of the lands which have been successfully irrigated have been ruined by an accumulation of seepage waters and alkali. This injury is entirely unnecessary if proper precautions are taken, which can be economically applied to the lands. In the level stretch between Salt Lake City and the Great Salt Lake, where many unsuccessful attempts have been made to farm the lands, it was found that about 60,000 acres of now practically worthless land can be reclaimed at an estimated cost of $20 an acre through drainage and proper methods of irrigation, after which the lands will have an estimated value of about $75 or $100 an acre. The systematic reclamation of alkali lands has never been attempted in this country. There are in the irrigated districts probably more than a million acres of lands which can be profitably brought back into fertility. These lands are usually favorably situated for cultivation and lie below present canal systems. In order to encourage their reclamation the Bureau is carrying on reclamation experiments at various points in the West. These will show to the farmer the results and necessities of drainage, and will demonstrate the feasibility of this method of reclamation. In Egypt over 2,500,000 acres have been reclaimed, and about 800,000 acres are in process of reclamation. It is believed that in a short while drainage will become a more common practice in the West, just as it has in other irrigated countries throughout the world.

Equally striking and valuable possibilities have been pointed out in other areas in the West as a result of the soil survey, and if the suggestions made by the Bureau reports are carried out larger areas may be irrigated with the available water supply and larger crops secured than at present.

SOIL MANAGEMENT.

Reference has already been made to the successful introduction of Sumatra tobacco on certain soils in the Connecticut Valley, and to the possibility of developing the agricultural interests of southern

Maryland through the adoption of the crops and methods which have proved successful on the same soils in southern New Jersey under practically the same climatic conditions. In all the areas such possibilities of improvement and progress are constantly presenting themselves to the parties who make the soil surveys, their experience in other areas enabling them to appreciate readily the needs and opportunities of the country; but with their rapid movement from place to place, necessitated by the widespread demand for the soil-survey work, they are often unable to impress the lessons of their discoveries upon the people with sufficient force to induce them to apply the knowledge in actual practice. It requires so long a time and such constant attention to establish and develop agricultural industries that it has seemed advisable to organize in the Bureau of Soils a division of soil management to work out the various problems presented in the areas surveyed. Such a division has now been established, and it is confidently believed that many of the lessons gained in the course of the survey can be applied in a practical manner to the benefit of the agricultural community.

SOME PROBLEMS OF THE RURAL COMMON SCHOOL.

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Director of the Office of Experiment Stations.

INTRODUCTION.

The elementary public school, free to all children who choose to come, has been for many years a distinctively American institution. With the spread of population westward it has been carried into every State and Territory. Its influence in maintaining the democratic spirit of our people, in welding together the diverse elements of our native and foreign-born population, in raising the general level of intelligence to a comparatively high plane, has been too great to be measured. In our wonder and admiration at the marvelous results which the public school has achieved we have too often forgotten its shortcomings and have at times been in great danger of making it a petrified institution, thus depriving it of the progressive life which alone can enable it to adapt itself to a changing material environment, an advancing knowledge, and a more complex civilization. We may have even forgotten that there has never yet been a time when there were schoolhouses enough in this country to accommodate all the children of school age, but that multitudes of these children have been and still are deprived of the opportunity to acquire even the simplest rudiments of education. With the growth of large towns and cities in rapidly increasing numbers the thought of the educational leaders was for many years largely engrossed in developing a public-school system which should meet the needs of these strong and active communities. Hence have arisen the graded schools, the public high schools, special courses in music, drawing, calisthenics, domestic science and manual training, skilled superintendence, free text-books, elaborate and well-equipped schoolhouses, and, in a word, a vast and complicated system of public education for the urban youth. In more recent years this system has been increasingly adjusted to meet the varied industrial needs of city populations. The courses in both the common and high schools in the cities are being changed from year to year with a view to providing instruction which shall relate more closely to the requirements of the store, the countingroom, the workshop, and the professions. While there has thus been great and multifarious activity in the educational affairs of the cities, the progress in the rural communities has

been along very narrow lines. With the rapid spread of the agricultural population over a vast territory and the industrial revolution produced in great regions through the liberation of millions of illiterate slaves, the chief effort of educational forces in the rural districts has been to provide schools of some sort to meet at least the simplest educational needs of a great and widely scattered multitude of children. The motto with which the educational leaders sought to inspire the country people was, "Let us put a schoolhouse in every valley and on every hilltop." Until very recently little attempt was made to change or improve the curriculum of country schools. Those advanced leaders of educational effort who went out to study the problems of the country schools generally brought back a discouraging report. "These schools," they said, "are in a bad way, but we see no present hope of their improvement. Let us go on building schoolhouses and trust the future to bring forth some plan for the betterment of the schools." Fortunately, however, a few of these advance agents of educational progress had more courage and hopefulness than the rest, and through their efforts great interest in plans for the improvement of the country schools has at length been aroused in educational circles. At meetings of teachers and school officers the country schools have a larger place on the programme and their needs and requirements are more earnestly and hopefully discussed.

INFLUENCE OF PRESENT EDUCATIONAL MOVEMENT ON AGRICULTURE.

It is the purpose of this article to set forth some of the features of the new movement for the improvement of the rural schools, and this is done because it is believed that in this movement is contained much that promises to work to the great advantage of our agriculture, as well as to the enlarged welfare and happiness of our rural people. Without doubt the character of our agriculture is rapidly changing. It is becoming more highly diversified, its operations are becoming more complicated, the use of intricate machinery is becoming more common and necessary, and, in general, successful farming now requires a wider knowledge and a greater skill. The discoveries of the agricultural experiment stations and the broader technical training of the leaders of agricultural progress in the colleges are producing profound effects on our agricultural practice, the final results of which are but dimly appreciated by the masses of our farmers, but which will surely make the lot of the rightly educated farmer of the future more fortunate and the lot of the ignorant farmer relatively more deplorable. It is very important, therefore, that the agricultural people should study the problems of the public schools and should become alive to the relation of these schools to the progress of their art. When every other industry is allying itself closely with the schools and seeking changes in the school courses which will

be to its benefit, it will not do for agriculture to hold aloof from the educational movements of our times and attempt to run a twentieth century agricultural system on the basis of an eighteenth, or even nineteenth, century school system. It is true, as we have said, that our educational leaders are becoming aroused to the importance of improving the rural schools and are exerting themselves more strenuously in this direction with every passing year, but it is not best to leave the shaping of this movement entirely to the schoolmen. The patrons of the schools, the farmers themselves, should take an active part in this movement, impress upon the schoolmen their real educational needs, and help to adjust the public schools to the advancing requirements of agriculture. We propose, therefore, in this article to bring the problems of the schools to the attention of our farmer readers and to open the discussion of these problems from the standpoint of the needs of our agriculture and our agricultural people.

THE PRIMARY TASK OF THE PUBLIC SCHOOLS.

Obviously the fundamental problem of our public schools is to give all the people at least the simplest rudiments of education. This primary task they have not yet accomplished. According to the census of 1900 the population of the United States (excluding the insular possessions) is over 75,000,000. The number of men of voting age is 21,329,819, of whom 2,326,295, or about 11 per cent, are illiterate, that is, out of every 1,000 men of voting age 109 can neither read nor write. Of these illiterates, 620,000 are foreign born, 688,750 are native whites, and 977,049 are negroes. The illiterate voters represent a total illiterate population of probably 7,500,000, or one-tenth of the whole population. The men engaged in farming in the United States aggregate in round numbers 7,500,000, representing a total agricultural population of 30,000,000. If the number of illiterates in the rural population is not relatively greater than in the population generally, the number of illiterate farmers must be at least 800,000, and the illiterate agricultural population must aggregate 3,000,000. (See fig. 1.) Since the vast majority of the illiterate negroes are engaged in farming, this is probably a low estimate of illiteracy among our farmers. It will thus be seen that illiteracy is one of the great obstacles to the progress of agriculture in the United States. This inert mass of absolute ignorance constitutes not only a menace to our social and political institutions, but it prevents the introduction of better crops, better methods of cultivation, and better farm machinery in many sections. In these regions, even if intelligent farm managers are available, their efforts to improve agriculture are largely defeated by the stupidity of the only farm laborers who can be procured to perform the necessary routine operations. There is, then, yet a great work to be done by the public schools in our rural communities

in removing the dead weight of illiteracy from our agriculture. Let us see how far they are making progress in this direction. In 1890, out of a total school population (between the ages of 5 and 18) of 18,543,201, the Bureau of Education reported that 12,722,581 pupils were enrolled in the common schools of the United States. While there are no exact statistics showing how many of these scholars were in the rural schools, it is probably fair to estimate, on the basis of

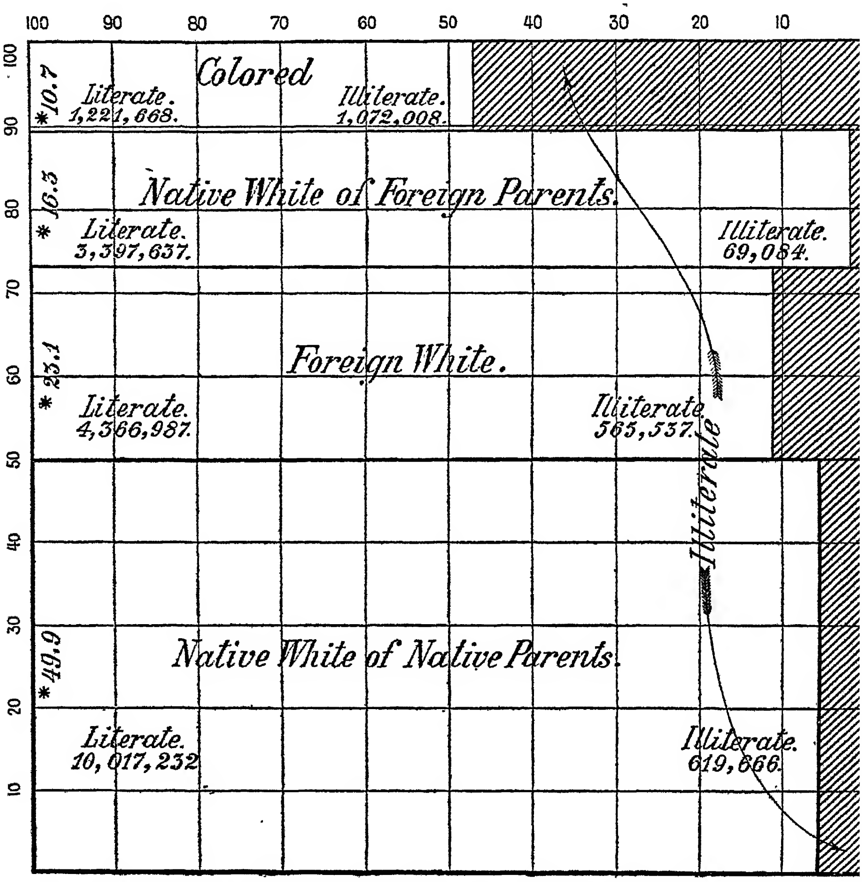

FIG. 1.—Diagram showing literacy of males 21 years of age and over in different elements of the population in the United States: *Percentage of total male population 21 years of age and over.

the farming population, that the number of pupils enrolled in these schools was not less than 6,750,000. In the same way we find that in 1900 the total school population was 22,253,050, and the number of pupils enrolled in the common schools 15,341,220, of whom 14,821,969 were in the elementary schools, and the number enrolled in the rural schools was approximately 8,000,000. The average daily attendance for the whole country was 8,153,635 in 1890, and 10,513,518 in 1900. The average length of the school term in 1890 was 134.7 days, and in

1900, 144.6 days. The average number of days of attendance by each pupil enrolled was 86.3 in 1890 and 99.1 in 1900. These statistics indicate that there has been some improvement in the attendance of pupils on the common schools during the past decade. The length of the school term in 1900 varied from 177.1 days in the North Atlantic States[1] to 99.7 days in the South Central States, the extremes being 189 days in Massachusetts and Connecticut and 70.8 days in North Carolina. The average number of days of attendance also varied from 128.3 in the North Atlantic States to 66.6 in the South Central States, the extremes being 145.7 in Massachusetts and 36.6 in North Carolina. There were 15 States in which the average number of days of attendance for each pupil did not rise above 75, or 15 school weeks of 5 days each. These figures bring out in a striking way the decided limitations still imposed on our youth as regards the acquiring of even an elementary education, and when coupled with the statistics of absolute illiteracy show conclusively that the country is yet far from the desirable goal of universal popular education.

THE PROBLEM OF PROVIDING ELEMENTARY EDUCATION FOR ALL.

The most pressing problem of the schools, and especially of the rural schools, is the providing of adequate ways and means for giving every child within our borders a good elementary education. To do this, we must find a way of getting all the children into the schools and holding them there long enough to give them satisfactory training. As the present inadequacy of our educational system presses heavily on the rural population, it is high time that our farmers took a more active part in the movement to extend and complete the system of public schools. To provide every child of school age in this country with a good common school and to keep that school in operation eight or nine months in the year will require the annual expenditure of a large amount of money, most of which must be raised by public taxation. To levy the school taxes so that the burden of this taxation will be equitably distributed and at the same time the school privileges of the children reasonably equalized, requires very wise school legislation. This legislation must of course be based on an intelligent public appreciation of the factors involved in the problem. Thus far the financial support of the public schools in this country has

[1] The geographical divisions of the Twelfth Census are as follows: North Atlantic—Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania. South Atlantic—Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida. North Central—Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas. South Central—Kentucky, Tennessee, Alabama, Mississippi, Louisiana, Texas, Indian Territory, Oklahoma, Arkansas. Western—Montana, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Idaho, Washington, Oregon, California.

been left to the States and the local communities, except that Congress has given the States in which the public lands were located large grants of these lands from which to make permanent endowment funds for the schools. From time to time propositions for National aid to these schools through taxation have been brought before Congress, but constitutional and other objections have prevented favorable action by that body in this direction. Within the States there have been various plans for raising the school revenues. There is first the interest on the endowment funds created by the sale of the public lands granted to many of the States by Congress. In nearly all the States which do not have the land-grant fund, permanent school funds have been created out of their own resources. The annual revenue derived from these land-grant and other permanent funds constitutes, however, only a small fraction of the aggregate funds required for the maintenance of the public schools, and with the increase of population it is a constantly decreasing fraction. In 1889-1890, out of a total school revenue of $143,000,000, about $7,500,000, or 5.4 per cent, was derived from the income of permanent funds. In 1899-1900 this permanent income had declined to 4.2 per cent of the total revenue, being only $9,500,000 out of about $218,000,000.

METHODS OF PROVIDING MONEY FOR PUBLIC SCHOOLS.

By far the largest part of the money required for the proper maintenance of the public schools is and must continue to be raised by annual taxation. The method now generally followed is to provide part of this annual school fund by State taxation and part by county, town, school district, or other local taxation. In 1899-1900 about 69 per cent of the total amount of school revenues was raised by local taxation and 16 per cent by State taxation. But the relative amounts raised by State taxation in different States varied from nothing to 77 per cent. Various local conditions, as regards especially distribution of population and of wealth, will undoubtedly always prevent anything like uniformity in the methods of taxation for school purposes in the different States, but experience indicates that it is very desirable that a few general principles should be commonly applied in levying school taxes. Among these principles are the following: (1) The aim should be to provide every child of school age with equal opportunities for an education; (2) the whole wealth of the State should be made available for educating all the youth of the State; and, (3) the individual communities requiring schools should contribute according to their means toward the support of their own schools. It is the failure to observe one or more of these principles which has resulted in keeping the percentage of illiteracy so high, and has either imposed a burden of taxation on the rural communities greater than they could bear or

has left them without proper inducement to exert themselves to contribute their just share toward the maintenance of their own schools. A few historical examples will serve to illustrate these points.

In Massachusetts for many years it was the plan to throw the whole burden of school maintenance on the local communities, but with the increase of manufacturing and the consequent concentration of capital and population the schools in the towns and cities obtained financial resources which enabled them to far outstrip the country schools in every particular. Many of the rural communities bravely struggled to maintain their schools on a proper relative basis of efficiency, but this led to increase in the burden of school taxation, which constituted an intolerable weight on agriculture in those communities. At length the hopelessness of this effort became apparent to the educational leaders of this State, and under their guidance the State was brought in some degree to see its duty toward the financially weak school districts. A system of State aid to country schools on the basis of their own reasonable efforts to help themselves was devised and has already contributed to the improvement of the schools. But it will probably be some time before this wealthy State realizes the full measure of its obligation to equalize the school advantages of all its children and contribute as it ought to the maintenance of its rural schools.

In North Carolina, on the other hand, a very large share of the school moneys has been raised by State taxation. This was perhaps a natural course to pursue in a community where the population was scattered and the aggregate wealth comparatively small, but this plan has apparently paralyzed local effort and kept the average length of the school term at a very low level. The average amount annually contributed by each adult male in North Carolina to the support of schools through local taxation is only 6 mills, while in Massachusetts it is $16.26. In the latter case the amount is undoubtedly excessive, especially as regards the country taxpayers, but it is nevertheless true that much greater interest would be taken in the public schools and better provision made for them in many regions if their support were thrown more largely on the people for whose direct benefit the schools are established. The scheme of local taxation will be most efficient if the State aid to the school fund of the local communities is conditioned on the amounts raised by local taxation for this purpose. In Michigan, for example, districts which do not maintain a school during the period required by law forfeit their share of the State school tax and the primary school fund, and it has been found that under this incentive it seldom happens that even the weakest districts fail to keep their schools open during the prescribed term. In Massachusetts a portion of the State fund is divided among the townships on the basis of the ratio which the town's school tax bears to the whole town tax;

the larger the ratio the more help the town receives. In that State the principle is recognized that the poorer the community the more it needs the help of the State to properly maintain its schools. Thus, $275 is given annually to towns whose assessable valuation falls below $500,000; $200 to those whose valuation is between $500,000 and $1,000,000, and $100 to those whose valuation is between $1,000,000 and $2,000,000.

NEED OF ADJUSTMENT OF STATE AID AND LOCAL SELF-HELP.

The relative amounts of school taxes which the State and the local community should raise will undoubtedly vary in different States according to the variations in distribution of wealth and population as between the rural and urban communities. The main thing is to have such an adjustment of State aid and local self-help as will make all the schools of the State efficient and keep the patrons of the schools alive to their best interests. But experience shows that even where there are plenty of good schools provided at public expense there are often parents so indifferent to the welfare of their children as to be willing to let them grow up in ignorance. This evil is perhaps more prevalent in the cities, but too often the farmer is tempted to keep his children out of school because of the money value of their labor in the house or on the farm. The few dollars the child can earn by helping in the plowing, weeding, or harvesting is considered of more account than his preparation in school for the labors and responsibilities of his after life. To check this evil and stamp out illiteracy a number of States have passed compulsory education laws, requiring the attendance at private or public school of children of school age. This is not the place to discuss the merits of such laws. It is sufficient for our purpose to point out that among the important educational problems yet to be solved in this country is the securing of the more general attendance of the children at even the elementary schools already provided for their education.

UNNECESSARY MULTIPLICATION OF SCHOOL OFFICERS.

While there has undoubtedly been a generally increasing interest in public education in this country during the past quarter of a century, various causes have unfavorably affected the rural schools, so that their relative efficiency has notably decreased. Even in communities where educational activity has been relatively great some of these causes have operated to the disadvantage of the schools. There is no doubt that the average rural school of the Northeastern and Central States is as a rule an educational agency of considerably less merit than it was a generation ago. Then these schools were often numerously attended by boys and girls who in many cases continued in them until

they were full-grown men and women. They were taught by the brightest minds in these communities, often in winter by college students and in summer by women from the academies. The range of studies, while narrow, was fundamental, and in that respect the country and city schools of that time were much alike. In a word, the country schools of that day were much more nearly sufficient for the educational needs of the times than those of to-day. Then the indefinite multiplication of schools seemed to the people and the schoolmen alike to be a good thing. A large amount of generous sentiment clustered around the little schoolhouse, and communities greatly prided themselves on the number of schoolhouses they could count within the township or the county. We see now that this movement was carried too far. For one thing it led to the creation of a vast number of small and often autonomous school districts, and thus to a great multiplication of petty school officials. In Wisconsin, for example, there are nearly 20,000 school officers. This has in recent years been greatly to the disadvantage of the country schools. As a rule, the officers of the country schools have no special training or fitness for the management of schools, and these schools have thus been very largely deprived of the skilled superintendence which the city schools now so generally enjoy. The school officers in the country districts too often are ignorant of the great changes which have been going on in the schools of the towns; they do not even understand what a good rural school really is; they look more at the cheapness than the efficiency of the teacher; they are willing to intrust the school to the care of some relative or neighbor's daughter without reference to her qualifications as a teacher. In a word, they do not look outside their own little bailiwick or consider their relations to the great educational world, by whose standards the merits of their schools are to be judged.

UNWISE MULTIPLICATION OF SCHOOL DISTRICTS.

The unwise multiplication of school districts has also kept the amount of money available for school purposes in each district at so low a level that it has been increasingly difficult to procure or retain well educated and efficient teachers in the rural schools. The low rate of wages offered by many of these schools prevents the employment of teachers who have had professional training in the normal school, or even a high-school education. Many of the teachers in the rural schools have had only the limited education given by the schools in which they teach. The brightest and ablest of even these poorly trained teachers are constantly being drawn away to get more education and ultimately to find better positions in the urban schools. For this and other reasons, the country schools are constantly changing teachers. There is, therefore, too much truth in the statement made by a school officer after an investigation of the schools of his State

that "country teachers are in most cases young, immature, half-trained, ineffective, and lacking in professional ideals and ambitions. They are of two general classes—the callow apprentice class and the old stagers who have been too inefficient to get employment elsewhere." Meanwhile, in many of the country schools the number of pupils has been declining rapidly. Some districts have been depleted by removal of the population to other farming regions or to cities; in some the average family is not as large as formerly, and thus the school population has diminished; in others the boys and girls are taken at a comparatively early age to the better schools in nearby towns or cities. Thus, it has come about that many country schools have too few pupils to stimulate the teacher to do his best work or to give the pupils that very important element of his education which comes from mental contact with his fellows. Any teacher who has taught in a country school will testify that one of the most discouraging features of his work comes from the fact that the pupils do not as a rule feel the inspiration of a highly competitive life such as is found in the larger communities. This disadvantage is greatly intensified when there are not enough pupils in a school to make classes in which mind may wrestle with mind in the daily recitations or even on the playground. In Connecticut, for example, one-tenth of the schools have an average attendance of less than 8; in Wisconsin nearly 1,000 schools have an average attendance of less than 10; in Iowa over 2,500 districts report an average attendance of less than 10, and over 9,000 of less than 20, out of a total of about 13,000 districts in the State; in Indiana over 4,000 schools, or one-half the total number, have an attendance of less than 20. The largeness and importance of this problem may be seen from such facts as these from two of the most important agricultural States. In Wisconsin over 200,000 pupils, or half the whole number in the State, are in ungraded schools, and 95 per cent of these pupils do not carry their education beyond these schools. In Iowa, out of a total enrollment of about 550,000 pupils, over 375,000 are in the ungraded schools, and in this State 3,508 of the teachers licensed in 1898 had had no experience and 3,825 had taught less than one year. The general school officers of the several States are now thoroughly alive to the evils of this situation, and their reports abound in serious statements that the problems of the country schools are by far the most pressing educational problems of the present time. Moreover, they are making earnest efforts to improve the condition of these schools, and their writings show that they are not blind to the natural advantages which the country schools possess. For in this discussion we must not lose sight of the fact that in some respects the country boys and girls will always have the advantage of their city fellows. The free and open life of the country imparts a vigor of mind and body of a much higher average than is found in the cities; the occupations

of the farm necessitate a varied exercise of both mind and body which is much broader than that enjoyed by the average city youth, whose range is confined to the school, the street, and the factory or the store; the country environment furnishes a much wider range of materials for interesting study, and the great pity is that these are now almost entirely neglected by the schools. Given a bright, energetic, and well-trained teacher and 25 to 40 healthy and active country children between the ages of 5 and 18, and we may easily have a school whose educational results will be of great merit, though the strict grading and the elaborate equipment of the city school are lacking. There are such schools, and they are doing a grand work; but these serve at present only to brighten in a slight degree the dark picture which portrays the unsatisfactory condition of the average rural school. The fact remains that if we are to improve our agriculture and compete on the best terms with our rivals in the world's market, if we are to make the conditions of country life attractive enough to keep the bright boys and girls on the farms, if we are to equalize the advantages of country and town so as to maintain an intelligent, prosperous, progressive, and contented yeomanry, we must give immediate and effective attention to the needs of the rural schools. And this is just as true of the most thriving agricultural communities as it is of those regions where agriculture is overshadowed by other industries or where public education has never yet flourished. The farmers have this matter in their own hands; they can have a better state of things if they will; and now that the educational leaders are moving actively for the improvement of the rural schools, nothing but the indifference or the opposition of the people most concerned can defeat their laudable efforts.

CONSOLIDATION OF SCHOOLS AND FREE TRANSPORTATION FOR PUPILS.

There is general agreement among the school authorities that the first thing to be done is to reduce the number of small school districts, to make the township the smallest unit of school management, and as far as possible to consolidate the country schools wherever the average attendance falls below 20. This carries with it the proposition to provide free transportation for pupils whenever they live beyond a reasonable walking distance from the schools. The movement for the consolidation of small schools has already been in progress long enough to have demonstrated that when properly managed it will produce excellent results. So rapidly has legislation opened the way for this change that it will probably be a surprise to many readers to learn that in eighteen States transportation of pupils at public expense is already permitted by existing laws. This is at present the most important movement affecting the rural schools, and it will be well, therefore, to study it more closely. The arguments for and against

the consolidation of schools and free transportation of pupils have been very clearly stated by Mr. A. W. Edson, an agent of the Massachusetts State Board of Education,[1] and we can perhaps not do better than to give the substance of his arguments here.

The favorable arguments are:

(1) It permits a better grading of the schools and classification of pupils. The pupils can thus be placed where they can work to the best advantage; the various subjects of study can be more wisely selected and correlated and more time can be given to recitation.

(2) It affords an opportunity for thorough work in special branches, such as drawing, music, and nature study. It also allows an enrichment of the course in other lines, giving a chance, for example, for the introduction of some agricultural instruction.

(3) It leads the way to more weeks of schooling and a higher grade of instruction.

(4) It insures the employment and retention of better teachers.

(5) It makes the work of school supervisors far more effective.

(6) It adds the stimulating influences of large classes, with the resulting enthusiasm and generous rivalry. The discipline and training thus obtained are invaluable.

(7) It affords the broader companionship and culture that come from association.

(8) It results in a better attendance of pupils.

(9) It leads to better school buildings, better equipment, a larger supply of books, charts, maps, and apparatus. The large expenditure implied in these better appointments is wise economy, for the cost per pupil is really much less than the cost in small and widely separated schools.

(10) It quickens public interest in the schools. Pride in the quality of the work done secures a greater sympathy and better fellowship throughout the town.

To the above arguments advanced by Mr. Edson, may be added one which is of importance as concerns regions where the population is scattered:

(11) It affords young children, and especially girls, desirable protection on their way to and from school.

The objections urged are:

(1) It may result in decreased valuation of farms in districts where schools are closed. This has been negatived by the experience of the communities which have tried the new plan.

(2) It necessitates the longer absence of young children from home and the providing for them of a cold lunch rather than a warm dinner. This is a real objection, and should be reduced to a minimum by having a teacher remain with the children during the noon hour.

[1] Annual Report Massachusetts State Board of Education, 1893-1894.

(3) It may bring danger to health and morals. The children may be obliged to travel too far in cold and stormy weather, or to walk a portion of the way to meet the team and then to ride to school in damp clothing and with wet feet; the driver may be an improper person and the conveyance unsuitable; the children may be brought into too close association with unworthy comrades. These are objections which may be largely done away with by the school authorities, whose duty it is to provide proper drivers, suitable conveyances, and reasonable routes. They are really no greater than those which arise from the children walking all the way to school in country districts, often along lonely roads.

(4) It may bring additional expense to the parents to provide proper clothing when the children go to a central school. This has been found to have very little weight.

(5) It removes an ancient landmark and is a decided innovation. This is, alas, an objection of great weight with a considerable class of the patrons of rural schools, who choose to live, move, and die as did their ancestors. Time and patience are required to overcome this objection, but the more progressive people of the rural communities can hardly be expected to pay much heed to it.

The States in which the consolidation of schools and the transportation of pupils at public expense are now being tried to a greater or less extent are: Connecticut, Florida, Indiana, Iowa, Kansas, Maine, Massachusetts, Nebraska, New Hampshire, New Jersey, New York, North Dakota, Ohio, Pennsylvania, Rhode Island, South Dakota, Vermont, and Wisconsin. This plan was inaugurated in Massachusetts in 1869, and has been gradually and more rapidly extended with the passing years. In 1890–1891 the amount expended for transportation in that State was $30,649, and in 1899–1900 it was $141,754. In Vermont the amount thus expended has increased from $11,122 in 1893–1894 to $26,492 in 1899–1900. In Ohio transportation was first tried in 1892 under a special law framed so as to apply to the township of Kingsville only; the next legislature extended it to three counties, and in 1898 a law covering the whole State was passed. Twenty-three townships in Ohio now have their schools completely centralized, and there are hundreds of towns where there is partial centralization. In Indiana transportation of pupils is practiced more or less in 44 counties.

In summing up the financial results of the centralization of the rural schools thus far attempted, the United States Bureau of Education states:

It is the general experience that a saving of funds is effected through consolidation of schools. Of the towns in Massachusetts that have tried the plan 68 per cent report a less cost after consolidation, and only 8 per cent an increased cost. Of 124

New Hampshire towns, 118 report less cost with conveyance as compared with maintaining local schools. Connecticut transported 849 pupils in 1898–1899 at a cost of $12,000, or $14.14 per pupil; Vermont 2,062 for one year at a cost of $26,492, or $12.85 per pupil. These are averages. In individual cases the cost varies greatly, according to the particular circumstances in each case. The testimony is very general that consolidation results in improved schools and is well-nigh unanimous that attendance is more regular. In cases where centralizing the schools would be bene-

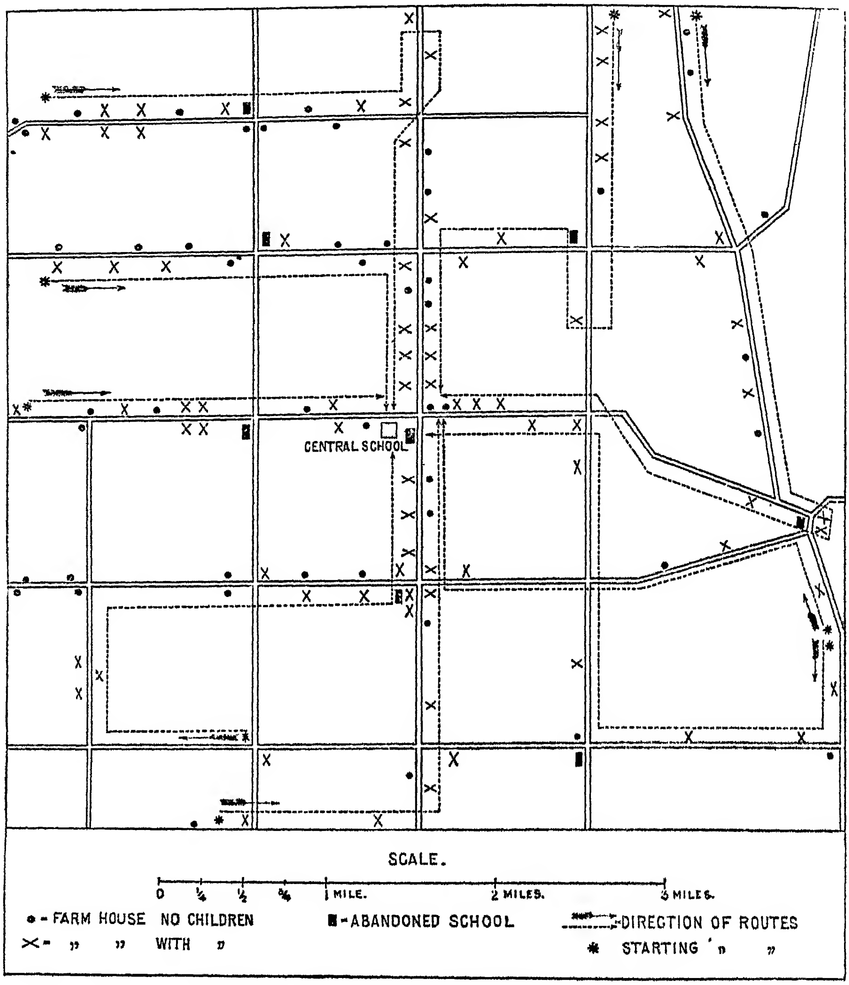

FIG. 2.—Diagram of Gustavus Township, Trumbull County, Ohio, showing transportation routes.

ficial, it would seem that the manifest and fundamental advantages to be gained must in the end prevail over the inertia of conservatism, unreasoning prejudice, or petty self-interest, and such appears to be the actual trend of events. The just apprehensions of parents may be allayed by procuring fit and trustworthy drivers and making suitable regulations.

The centralization of the schools is brought about either by bringing the pupils from outlying schools to a village schoolhouse already

existing or by building a new schoolhouse to accommodate the pupils brought from several small schools. The routes for the carriages are arranged so as not to require any pupil to ride a very long distance. How this may be accomplished in a township is illustrated by the diagram (see fig. 2). The conveyances are usually hired on contract, and are commonly covered wagons (see fig. 3). In a few cases provision has been made for heating the wagons in very cold weather. Besides conveying the children to school, these wagons are sometimes utilized for carrying messages, library books, and packages, or even the mail, and the drivers do errands at the villages for their rural patrons during school hours. In Indiana it is thought by the State superintendent of education that one school in a township 6 miles square would often be sufficient. In that State the law requires the central school to be near

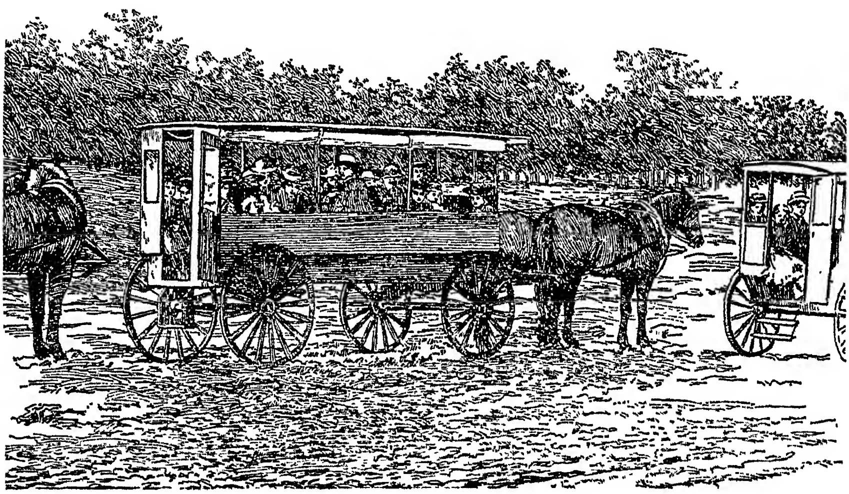

FIG. 3.—Wagons used for transporting school children.

the geographical center of the township. The central schools contain from 6 to 8 rooms, and thus permit of the establishment of a number of grades, after the manner of city schools. In both Indiana and Ohio high schools are being established as the result of centralization of the common schools, and some of these high schools are away from the villages. Township libraries are being established; also lecture courses for adults in the evening or Saturday afternoon.

While it can not be claimed that centralization offers a panacea for the ills of the rural schools, and there are doubtless many regions where this plan can not be economically or wisely adopted, the movement in this direction is a very encouraging element in our present educational situation. There is good reason to believe that it can be widely applied and that it will be an important factor in bringing about that reasonable equalization of the advantages of city and country life for which

there is now much better reason to hope than ever before. Along with such things as rural free delivery of mails, cheap telephones, trolley cars, and good roads, the free transportation of children to good public schools is likely in the near future to play an important part in betterment of life on the farm. It adds another agency for breaking down the barriers of isolation and stagnation which have so often kept the farmer out of harmony with the world in which he lives, and which have caused so many of the farmers' children to leave the country for the greater attractions and the greater uncertainties of the cities.

ADVANTAGES OF BETTER ORGANIZATION OF RURAL SCHOOLS.

With the better organization of the rural schools will come very much wider opportunities for the enrichment of the courses of study by the introduction of those subjects which are most directly related to the improvement of agriculture and to the inculcation of a love of country life in the minds of the youth on our farms. All around country schools lies a wealth of material for the most attractive and valuable studies which, thus far, has been almost entirely neglected for the lack of knowledge and the absence of the skilled teacher. Knowledge has now been supplied by the researches of those scientific men who have gone beyond the principles and abstractions of science, and have discovered the real relation of the facts and phenomena of nature to the daily concerns of the industrial pursuits of men. In recent years great strides have been made in the studies on those things in nature with which the farmer has to deal. The secrets of air, soil, plant, and animal are now, in large measure, the common property of mankind. Science is no longer the mere classifying and naming of objects and phenomena. It is more and more the explanation of the activities of the natural world and of the advantage which man may take of these activities. The nature of the soil as related to the crop which will grow in it, the life of the plant as related to the amount of grain, or forage, or fruit it will bear, the body of the animal as related to the food which it requires for maintenance or growth, the life histories of injurious insects as related to the means for their repression—such things as these science has now to offer to the student who makes his home on the farm. But there is still needed in far greater number the skilled teacher to open the eyes of the farm boys and girls to the natural objects amidst which they live, and to start them in the right path of investigation of these objects with relation to their daily work on the farm. A beginning has, however, been made in training the teachers for this work, and with the growth of movements for the improvement of the rural schools more openings will come for such teachers. The enthusiastic and successful labors of such men as Professors Bailey and Roberts, of Cornell University, in the State of New York, in formulating plans for nature study in the rural schools and

in instructing teachers how to make such instruction effective, have borne much good fruit. A number of other States have already taken up this movement, and special efforts are being made to secure the interest of teachers and parents.

Nature study is not to be confounded with the systematic teaching of agriculture, for it is, in fact, a very different thing. It deals, however, with many elementary facts and principles on which the study of agriculture should be based, and is, therefore, in large measure a preparation for this study in later years. The subjects of nature study in the rural school may most appropriately be largely drawn from those things with which agriculture directly deals. The common plants and trees of the farm, the domestic animals, the beneficial and injurious insects in any agricultural region, offer abundant material for nature studies. And the intelligent teacher may easily take advantage of the fact that the pupil lives in the midst of these things to so open his mind and heart to the beauties and delights of the world about him that country life will have such an added charm that in after years he will not be so ready to desert it. This nature-study movement has been so recently inaugurated, and has, thus far, affected only such a limited number of the rural schools, that it is still necessary to repeatedly urge its importance, and, perhaps, more particularly its feasibility, wherever there is a well-organized school and a competent teacher.

The greatest obstacle to the spread of the movement to introduce nature study into the rural school, aside from the lack of competent teachers, is found in the conservatism of the patrons of these schools. Reading and writing and arithmetic they know, but what, forsooth, is this new-fangled nature study? The subject is often so presented to their minds that it seems to them as if the new study must necessarily crowd out some of the old ones, or at least weaken the already too imperfect hold which the average pupil has on such fundamental things as spelling, writing, and arithmetic. But this need not be so. Instruction about plants and animals and insects may easily and naturally be connected with exercises in composition and in numbers, which will bring into practical use from day to day what the child is learning in his lessons about the English language, arithmetic, or geography. Properly taught, nature study will not crowd out any essential branch of learning from the common schools, but, on the other hand, it will stimulate interest in them all as the pupil discovers that they may be directly related to his daily life and the world about him. Once the child's mind is awakened to the innumerable wonders of nature, and his interest excited in explanations of the phenomena with which his farm life makes him familiar, it will be far easier than ever before to stimulate him to continuous endeavor to widen his knowledge through reading, as

well as through observation. He will have more thoughts to put on paper, and he will often wish to draw objects he has seen. His view of the business of the farm will also be radically changed. The subject of milk and its products, for example, may be so presented to a class of pupils of 12 years of age that they will have a fairly intelligent idea of the composition of dairy products and of the changes that take place in the making of butter and cheese. Thereafter their view of the business of dairying will be very different from that of children who have never learned these things. The country boy oftentimes has a wonderful familiarity with nature. The things he has learned about animals, and birds, and trees; the lore of the fields, and woods, and streams—all this may be of great practical use to him. Connect this with what other students of nature have found out, and how easily this boy's knowledge of the world about him may be broadened and deepened. School will then become to him a place where he may learn things which will add a greater pleasure to his hunting and fishing, and even a new interest to the planting of seed or the milking of cows.

When people think about the teaching of agriculture in the common schools they often make the mistake of supposing that what is meant is instruction in farm operations. But obviously this would be impracticable in the ordinary public school. Plowing and reaping and milking must ordinarily be learned on the farm and not in school. But the school can help the pupil to do all these things more intelligently by teaching him why plowing is necessary and at what stage of a plant's life it is best to reap and how the dairy cow has been developed so as to yield such an abundance of milk. School is the place where we should learn to connect the practical and other knowlege we already have with what other men know who have lived in the past or in other places or have studied certain subjects very thoroughly. The child knows the English language to a considerable extent when he goes to school. By learning to read he broadens this knowledge and gains the power of learning what men in all the ages and in all the world have been thinking about and have discovered. Some of the things he may read will have a direct relation to his daily life, and the pity is that practical men are not better taught how to gather useful knowledge by reading. In a similar way the child knows something of the natural world when he goes to school. What he needs to find there is a teacher who can connect the child's limited knowledge of nature with what science has unfolded of nature's mysteries and can show how the discoveries of science may be applied to improve the life and practice of the farm.

Fortunately, in our day science is no longer a thing wholly apart from the affairs of common life. If we have grown up with the idea that science and practice are wholly and forever divorced, let us rid ourselves of this thought, for it is false. On the contrary, they are now joined in indissoluble wedlock, and their union is especially productive of good to agriculture in our times. If we will but study the needs of

the common schools with unprejudiced minds we will see that if they are to be brought into harmony with modern progress in agriculture, as well as in other industries, they must be developed so as to bring them into direct touch with the farm. The nature-study movement promises to do this, and for this reason farmers ought to take a great interest in it. It is related that a certain farmer discovered his son catching beetles, and asked what he was doing it for. The boy replied that his teacher wanted them to illustrate talks to the pupils on habits of insects, their ravages, methods of repression, etc. The farmer forbade his son catching any more "bugs," but could not help noticing that the little fellow continued his interest in them. He finally exacted a promise from the teacher not to take his son's time from books "to fool around with bugs and worms and millers." Not long after the son happened to let fall a remark in his father's hearing about some noxious insect, which showed him to be in possession of information worth some dollars to the farmer. The father's interest was thus aroused and the ban against nature study was removed. He was frequently seen out with his son collecting, and later on presented the school with a valuable collection of insects properly mounted. He had come to see that nature study had a direct relation to the improvement of agriculture.

True, nature study in the common schools is only in its beginning, and much experience will have to be gained before we learn its just limitations and develop its proper service; but this can only be done through its actual workings in the schools. Therefore, we say, open the common schools to instruction in nature, and relate that instruction directly to the farm. Insist that normal schools and teachers' institutes shall prepare teachers for this line of work.

IMPROVEMENT IN MATERIAL ENVIRONMENT OF SCHOOLS.

Greater public interest in the rural schools, their consolidation where practicable, and the enrichment of courses of study will bring about an improvement in the material environment of these schools. Substantial, well-arranged, well-heated, and well-ventilated schoolhouses will be the rule rather than, as now, the exception. (See fig. 4.) The grounds about the schoolhouse will be laid out so as to provide suitable playgrounds and shady nooks for out-of-door study and instruction. To stimulate interest in the planting of trees about country schoolhouses, the Department of Agriculture has recently issued a Farmers' Bulletin on this subject. Where circumstances will permit, school gardens will be maintained. These need not be large nor elaborate, but may easily be so managed as to furnish much material for instruction and an opportunity for the children to learn by doing things themselves. Such gardens are now successfully maintained about country schools in some places in this country and more

commonly in certain parts of Europe. (See Pl. I.) There will also be collections of seeds, dried plants, soils, minerals, insects, and other natural objects, not as curiosities, but as direct aids to instruction. Already much has been accomplished in some States in providing the country schools with useful libraries. In Wisconsin and California all the school districts have libraries, and in Connecticut, Minnesota, New York, Indiana, and Illinois much progress has been made in this direction. The public libraries are being most closely connected with

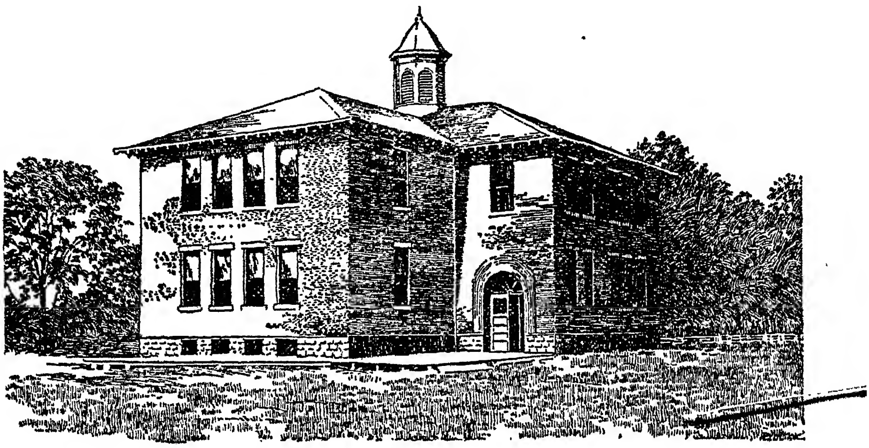

FIG. 4.—Central public school, Trumbull County, Ohio.

the public schools. In Massachusetts, for example, nearly every township has a public library to which the school children and their teachers have access.

UNION OF PARENTS AND TEACHERS FOR IMPROVEMENT OF SCHOOLS.

It will thus be seen that various movements are already on foot for the improvement of the country schools. The leaders in the educational field are more ready than ever before to try experiments which seem to promise useful results in the improvement of these schools. What is especially needed at this time is the hearty cooperation of the intelligent men and women on the farms, who send their children to these schools. And for this reason considerable interest is now being taken in a movement, starting in the State of Michigan, which seems to promise much by way of showing how parents and teachers may cooperate for the improvement of the schools. The account of this movement is condensed from an article by Mr. K. L. Butterfield in the Review of Reviews for April, 1901. The movement originated in Hesperia, a small country village in Oceana County, Mich., 12 or 15 miles from any railroad. In 1885 the teachers of this region, finding it difficult to attend the teachers' institutes, which were commonly held in other parts of the county, determined to have an association of their

FIG. 1.—PREPARING THE GROUND FOR SCHOOL GARDEN AT HAMPTON INSTITUTE, VIRGINIA.

FIG. 2.—CULTIVATING THE CROP IN SCHOOL GARDEN AT HAMPTON INSTITUTE, VIRGINIA.

own, and "it occurred to someone that it would add strength to their organization if the farmers were asked to meet with them." Mr. E. L. Brooks, who was one of the early leaders in this venture, writes about it thus:

The programmes were so arranged that the participants in discussions and in the reading of papers were about equally divided between teachers and patrons. An active interest was awakened from the start. For one thing, it furnished a needed social gathering during the winter for the farmers. The meetings were held on Saturdays and the schoolhouse favored was usually well filled. The meetings were not held at any one schoolhouse, but were made to circulate among the different schools. These gatherings were so successful that similar societies were organized in other portions of the country.

In 1892 Mr. D. E. McClure, since for four years deputy superintendent of public instruction of Michigan, was elected commissioner of schools in Oceana County. He undertook at once to make practical use of this coöperation of patrons and teachers to introduce needed reforms in the schools. "His first effort was to prepare a list of books suitable for pupils in all grades of the public schools. He also prepared a rural lecture course, as well as a plan for securing libraries for the schools. All these propositions were adopted by a union meeting of teachers and farmers." He then formed the Oceana and Newaygo Counties Joint Grangers' and Teachers' Association, and the work has since been extended to several other counties. The first association held an annual meeting continuing over several days, but in other cases a number of meetings are held during the year. Mr. McClure thus states the purpose and some of the results of the movement:

What was my ideal in organizing such associations?

(1) To unite the farmers who pay the taxes and support the schools, the home makers, the teachers, the pupils, into a cooperative work for better rural school education.

(2) To give wholesome entertainment in the rural districts, which from necessity are more or less isolated.

(3) To create a taste for good American literature in home and school and higher ideals of citizenship.

(4) Summed up in all, to make the rural schools character builders; to rid the districts of surroundings which destroy character, such as unkept school yards, foul, nasty outhouses, poor, unfit teachers. These reforms, you understand, come only through a healthy educational sentiment which is aroused by a sympathetic cooperation of farm, home, and school.

What results have I been able to discover growing out of this work? Ideals grow so slowly that one can not measure much progress in six or seven years. We are slaves to conditions, no matter how hard, and we suffer them to exist rather than rouse ourselves and shake them off. The immediate results are better schools, yards, outbuildings, schoolrooms, teachers, literature for rural people to read.

Many a father and mother whose lives have been broken upon the wheel of labor have heard some of America's orators, have read some of the world's best books, because of this movement, and their lives have been made happier, more influential, more hopeful.

More than 8,000 people have been inspired, made better, at the Hesperia meetings.

The Kent County association, organized in 1897, is itinerant and holds at least five meetings each year during the fall and winter. The membership includes farmers, teachers, school officers, and even pupils. At each meeting there are usually three sessions—Friday evening and Saturday forenoon and afternoon. "The average attendance has been nearly 500, about one-tenth being teachers. Many teachers, as well as farmers, go considerable distances to attend." The commissioner of schools in Kent County has thus summarized the results of the work of this association:

To teachers the series of meetings is a series of mid-year institutes. Every argument in favor of institutes applies with all its force to these associations. To farmers they afford a near-by lecture course, accessible to all members of the family, and of as high grade as those maintained in the larger villages. To the schools the value is in the general sentiment and interest awakened. The final vote on any proposed school improvement is taken at the annual school meeting, and the prevailing sentiment in the neighborhood has everything to do with this vote. And not only this, but the general interest of patrons may help and cheer both teacher and pupils throughout the year. On the other hand, indifference and neglect may freeze the life out of the most promising school. There is no estimating the value to the schools in this respect.

If a plan like this for combining the efforts of farmers and teachers for the improvement of the rural schools and the intellectual life of rural communities can be put into effective operation throughout the country it will undoubtedly prove a mighty force for the betterment of country life.

SUMMARY.

We have thus briefly stated what seem to us to be some of the most important and pressing problems of our rural common schools. They may be briefly summarized as follows:

(1) To provide schools for all the children and to bring all the children into them.

(2) To make the annual school term throughout the United States long enough to give the children thorough instruction in the fundamentals of common knowledge during the period of their school life.

(3) To directly relate the instruction of the school to the practical business of the farm through the employment of teachers in sympathy with farm life and the enrichment of the school course by the introduction of agricultural subjects.

(4) The improvement of the material equipment and environment of the school by the consolidation of small schools, the improvement of school buildings and grounds, and the establishment of school libraries and collections of materials for illustration.

(5) The making of the schools more thoroughly the centers for the intellectual life of the community by the cooperation of the farmer and his family with the teacher through associations like those now existing in Michigan, or through other agencies.

THE RELATION OF NUTRITION TO THE HEALTH OF PLANTS.

By Albert F. Woods,
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INTRODUCTION.

The writer will not attempt in this paper to do more than present a general outline of some of the most important problems of nutrition in relation to the health of plants and to suggest lines of research likely to prove of value to agriculture. Some of the most difficult, and therefore still unsolved, problems are to be found in plant and animal nutrition. Their study requires the most careful technical research, and every truth learned or process explained is of great practical value. The study and careful description of the symptoms of the various kinds of starvation and malnutrition have been greatly neglected by plant physiologists and pathologists. Similar symptoms may develop in the plants from the most diverse causes. It then becomes very difficult in many cases to diagnose troubles unless all of the conditions of environment and often also the hereditary tendencies are known.

OUTLINE OF RELATION OF NUTRITION TO HEALTH OF PLANTS.

Nutrition is a fundamental condition of life, both animal and vegetable. It is the process by which living organisms obtain and organize into living tissue the simple elements (carbon, hydrogen, oxygen, nitrogen, potassium, calcium, magnesium, phosphorus, etc.) of which they are made up, and which constitute what are called their food elements; or, briefly, it is the process by which living substance is organized out of nonliving substance.

All plants and animals may be resolved into the same primary elements, but in the processes of organization these elements enter into multitudinous combinations and relations to each other, making up the various organic materials and tissues. Each living cell has a tendency to organize its simple elements as the cell itself is organized, and there results more or less well-defined fixity of organization which has come to be accepted as a natural course in the reproduction of all individuals,

and which is designated as species or variety. It is evident, however, that the necessary elements must be available and the conditions for organization must be essentially the same as those under which the cell itself was organized if the same end is to be reached. Variation in these conditions of environment and food will produce variation in the plant. The kind and quantity of food available to plants is a prolific source of variation. For example, a plant grown on a rather poor soil compared with a plant of the same species grown on a very rich soil might not at first be recognized as the same. While at first there may be no essential difference except in size, in a few generations a distinct variation usually appears in the more highly nourished plants, which are in a state of great physiological activity, and become, therefore, much more sensitive to the conditions surrounding them. Closely correlated with food supply are temperature and light conditions, both of which exert a powerful influence on nutrition and growth.[1]

Every plant must have certain elements in order to live and complete its growth, and these elements must be in combinations available to the plant. In the vegetable kingdom, as a whole, there is great diversity in the power of plants to obtain their food elements from different substances, but with the ordinary agricultural plants there is not so much difference in this respect. While they all absorb the free oxygen of the air through roots, stems, and leaves, and obtain their nitrogen from nitrates, ammonia, and other simple compositions in soils mainly by absorption through the roots, none of the agricultural plants are able to absorb nitrogen directly from the air. The indirect absorption of free nitrogen will be discussed later. Carbon is obtained by plants mainly from the carbon dioxide of the air absorbed through the leaves and other green parts. Water and the various salts of calcium, magnesium, potassium, sulphur, phosphorus, etc., in solution are absorbed mainly through the roots from the soil. The relative amount of these different substances entering into the structure of plants may be roughly represented by the following analysis made by Johnson of the dry leaves and stems of clover:

Analysis of the clover plant.

	Per cent.		Per cent.
Carbon	47.4	Sulphur	0.12
Oxygen	37.8	Phosphorus	0.30
Hydrogen	5.0	Remaining ash	2.00
Nitrogen	2.1		

From 70 to 90 per cent of the weight of living plants is water.

[1] For a discussion of variation due to food and the various conditions of environment, see article by Webber in Yearbook for 1896, pp. 89-106.

In the ash of an oat plant the relative abundance of atoms of the various elements is well represented in the following:[1]

Various elements in ash of oat plant.

Element.	Percentage of composition.	Relative number of atoms.
Calcium	$CaO=12.1$	216
Phosphorus	$P_2O_5=8.8$	124
Potassium	$K_2O=45.9$	974
Chlorine	$Cl=6.1$	173
Sodium	$Na_2O=2.32$	60
Magnesium	$MgO=4.12$	114
Iron	$Fe_2O_3=0.54$	6
Silicon	$SiO_2=17.2$	287
Sulphur	$SO_3=2.86$	36

These analyses, however, give only the barest suggestion of the relative importance of the various food elements. It has been shown in the analyses by Wolff and other investigators that the quantitative composition of the ash of the same kind of plants varies according to the soil on which they are grown. Every plant, as Loew expresses it, "absolutely requires a certain minimum of each mineral nutrient, and in most cases, besides this minimum, it takes up not only an excess of these various compounds, but also substances which are perhaps useful, but not absolutely necessary for plant functions, such as sodium and silica." If a plant fails to obtain any of the elements mentioned, except, perhaps, silicon and sodium, it can not develop, and must finally perish. A decrease below the amount required for normal growth will retard growth and finally result in disease or death. On the other hand, an excessive amount, as in alkali soils, may be quite as injurious. It thus becomes a very important matter to know the chemical composition of soils as well as their structure and texture. It is difficult, however, to draw correct conclusions from such analysis unless all of the conditions influencing the growth of the plant are considered together. With the increase of the knowledge of the physiological importance and relationship to the plant of the various elements which it absorbs from the air and soil, the grower will be enabled to more and more control the growth of crops by modifying these conditions.

EFFECT OF SOIL CONDITIONS ON PLANT GROWTH.

The effect of soil conditions upon the growth and development of plants is well recognized. As already shown, if the water that plants contain is counted, the largest percentage of their substance, in fact

[1] Davenport. Experimental Morphology, Part II, p. 297.

everything except carbon and oxygen, comes to them through the soil by way of the roots, and the texture and structure of the soil affects decidedly the availability to the plant of the soil foods with air and water. Many agricultural plants have been more or less adapted to soils of a certain texture. If an attempt is made to grow a crop on a soil not well adapted to it the crop is likely to suffer, unless the skill of the cultivator is able to modify the conditions of growth to meet the requirements of the crop. Most of the ordinary field and greenhouse crops require abundant and readily available food for the maximum production and vigorous growth, but this food must not be in too strong a solution in the soil water, and the water itself must be readily available, though the soil, as a rule, must not be so wet as to exclude the air. It is more difficult to maintain these conditions in light, sandy soils than in soils containing more or less clay. It is also more difficult to manage a sandy, clay soil poor in humus and fibrous matter than one comparatively rich in fiber and humus. A light clay soil with humus and fiber derived from decaying roots and plant tissues, or manure if the soil is properly drained, will not easily become too wet or dry out too quickly. A great deal of soluble food can be absorbed by such a soil without danger to the roots of plants growing in it, and air is easily admitted to the roots. The mechanical condition of such a soil, apart from these other factors, also favors a strong development of roots.

In many cases it requires very careful watching to prevent starvation and stunting in light soils. These conditions, however, favor some crops, like sweet potato and peach. On the other hand, in very heavy soils there is danger from overwatering, except, of course, for crops like rice, which require wet soils. There is also danger from poor drainage and lack of air, causing a weakened development of roots and making them subject to root rot and other diseases. Sorauer[1] has described the ideal condition of a soil for ordinary field and greenhouse crops as "one in which it resembles a sponge and in which it will retain the greatest amount of nutritive substances and water without losing its capacity of absorbing air." Speaking of forcing-house soils, Bailey[2] says:

> They should not only be rich in available plant food, but they should be of a mellow and friable texture, so that water soaks through them uniformly, leaving them dryish and loose on top. A soil with much clay tends to run together, or to cement itself, especially if watered from a hose, and the plants tend to make a spindling and unwilling growth. On the other hand, a soil with very much manure or litter is so loose as not to hold sufficient water to keep the plant in health; or if it does hold the requisite moisture, it tends to produce a robust and overwilling growth at the expense of the fruit. Yet, despite all this, the skill of the gardener is much more important than the character of the soil, for a skilled man will handle even hard clay soils in such a manner as to give good results. The chief single factor of manipulation in determining the productivity of a soil in forcing houses is the water.

[1] Physiology of Plants, p. 56. [2] The Forcing Book, p. 50.

A HEALTHY BRANCH AND DISEASED BRANCHES OF NORTON GRAPEVINES.

[*1*, Healthy branch; *2*, *3*, and *4*, Diseased branches, showing short, compact growth due to unfavorable soil conditions.]

FIG. 1.—A DISEASED NORTON GRAPE.

[From vineyard near Charlottesville, Va. This view shows how the leaves fall from the new growth as a result of unfavorable soil conditions.]

FIG. 2.—TOBACCO FROM SAND CULTURES: UPPER PLANTS, EXCESS OF MAGNESIA; LOWER PLANTS, EXCESS OF LIME.

[From Bulletin No. 1, Bureau of Plant Industry, U. S. Dept. Agr.]

Sorauer[1] says:

> The practical experience of gardeners teaches us that a root can never have too much air, but often has too little. * * * As soon as we are able to satisfy the wants of roots with regard to water and nutritive substances, we may choose beads of glass or crumbled quartz instead of ordinary soil. Indeed, by timely changes of the nutritive solution and by constantly renewing the supply of oxygen, we can cultivate plants for years in water itself.

It is not profitable, however, to employ soils that require such close and constant attention, even when conditions are largely under control, as they are under glass. It is the aim of economical production to select a soil for a given crop that, with a minimum of labor expended on the part of the cultivator, will produce the desired results, and this is true in culture under glass as well as in field culture.

INJURIES TO PLANTS FROM LACK OF OXYGEN.

The greatest dangers due to unsuitable mechanical conditions of soils are poor drainage and consequent excess of water and lack of oxygen, bringing on asphyxiation, weakening, and even death of the roots of plants growing in such soils. Crops growing in heavy clay soils, especially where there is an impervious subsoil or hardpan, will often have many of their feeding roots killed by suffocation during extended wet periods, especially in spring or early summer. Roots forming in a moist or dryish soil are often killed in two or three days if the soil becomes saturated with water. The vitality of the whole plant is weakened, not only by the loss of its feeding roots, but by the development of injurious products, such as alcohols, in the cells of the roots that are not killed.

A peculiar disease of grapes that appeared a few years ago in Virginia was found by the writer to be probably due to asphyxiation of the feeding roots of the vines in "gumbo" soils. These soils occurred in spots through the vineyard, and during protracted wet weather remained saturated. In dry weather they became dry and hard, thus further excluding the air and injuring and preventing the normal and healthy development of roots. The leaves of the vines in these spots became small and yellowish, matured early, and fell off. The stems were shortened and were inclined to break at the nodes, and the fruit fell off before maturing. The vines struggled on a few years and then died. No parasitic fungus or insect could be found constantly associated with the disease. Everything indicated that it was due to the unfavorable soil conditions as described. Pl. II shows healthy and diseased branches and leaves of vines from this vineyard. Pl. III, fig. 1, shows a diseased vine, the new growth having shed its leaves.

Plants, especially trees, growing where the surface soil becomes caked and packed, are likely to suffer for want of oxygen for the roots.

[1] Physiology of Plants, p. 71.

The trouble is especially apparent along paved streets, where the open space of a few feet left around the trunk of the tree is often packed as hard as the pavement. In some cases the space is so small that, even if it were properly cultivated, not enough air could reach the roots after the tree reaches the age of ten or fifteen years. Under these conditions there is also often a lack of proper food and water, as well as a lack of air. The feeding roots slowly die and the vitality of the whole tree is weakened; the leaves turn brown along the edges early in the summer, and fall prematurely. The annual growth is shortened and here and there limbs die back. In this weakened condition the tree is likely to become the prey of insects and fungi, which attack roots, trunk, branches, and leaves, and death comes slowly or quickly, as the case may be. The only remedy in all cases of this kind is to loosen up the soil and let the air down to the roots, working in deeply some good manure to stimulate the new growth of feeding roots. All of the diseased and dead limbs should be thoroughly pruned out of the top, and if the tree has not been too greatly weakened its recovery may be effected. In the case of ordinary crops growing in soils that have caked on the top, careful cultivation is, of course, the remedy. Soils that behave in this way are universally benefited by stable or other similar organic manures, and in many parts of the country by liming.

Where the standing of water in the soil is the cause of the lack of aeration, drainage is, of course, the remedy. Crops and trees are often greatly injured by overirrigation or by excessive rains. This is especially likely to occur in very fine sands, which are at best poorly aerated.

It should be clearly understood that roots of all plants must have oxygen. If they do not get it they will die of suffocation. The plant will be poisoned by its own decomposition products, and will starve or become the prey of parasitic enemies, which it is too weak to resist.

SOIL FOODS NECESSARY TO PLANT GROWTH.

Important as the mechanical condition of a soil may be in its relation to the growth of crops, the chemical condition is not less important. As already stated, there are certain elements that are absolutely necessary to plant growth. Every soil must have these in an available form and of proper concentration. If there is too little of any one or all of the necessary elements, the crops growing in such soils will starve, and if there is too great an excess of soluble salts the roots will be injured. It is often a difficult matter to determine by the behavior of the plant what the trouble may be. Take, for example, the disease known as "chlorosis," or the production of yellow foliage, instead of the normal green leaves. The most common cause of this condition is the lack of available iron—either its absence altogether from a soil, or the failure of the roots to dissolve and absorb

such compounds as may be present. Sometimes, in the presence of an excess of lime, the roots are unable to dissolve the iron compounds and absorb them; and occasionally from a lack of oxygen, or the presence of parasites killing the root hairs and feeding roots, the plant is also prevented from absorbing the iron or any of the other difficultly soluble materials. Wherever the trouble is due to a lack of the iron, the addition of a soluble iron salt, such as iron sulphate, to the soil, or even spraying it on the yellow leaves, will usually cause them to turn green again. The lack of magnesium, lime, phosphoric acid, or nitrogen will also produce yellowing of many crops, and occasionally an excess of these substances will have the same effect, as will also the lack of water or excess of water, lack of light or excess of light. The different kinds of yellowing can be more or less easily distinguished by other pathological conditions occurring at the same time. Of course, the addition of iron in the latter cases of yellowing would have no effect, and the lacking nutrient must be supplied or the unfavorable condition corrected.

INFLUENCE OF MAGNESIUM AND LIME ON PLANT GROWTH.

The combination and ratio to each other of the various food elements which exist in soils have a marked influence on growth. It has been recently shown that magnesium is a poison to many plants unless accompanied by a readily available calcium compound. Plants become stunted when they have too much magnesium and not enough lime. As it will not be possible to go into this subject in detail here, it may be stated that Dr. Loew[1] has shown the physiological importance of magnesium and the part it plays in connection with lime in the nutrition of the plant. Plate III, fig. 2, reproduced from Dr. Loew's bulletin, shows the effect of too much magnesium on tobacco. The lack of fertility in many soils is undoubtedly due to an insufficient amount of available lime as compared with magnesium. Such soils are benefited by liming with a lime free from magnesium and are injured by a magnesium lime. On the other hand, soils poor in magnesium are benefited by a magnesium lime and injured by a lime free from magnesium.

While magnesium in the absence of lime acts as a poison, it is nevertheless absolutely necessary to plant growth. It is especially important in the formation of seeds, and the want of it is often not felt in the plant until this period of development is reached. A comparatively small amount is often sufficient to meet the requirements of growth up to the period of flowering or fruiting, but at this time, if a sufficient supply is not available, the plants fail to flower or set fruit, the flower buds not forming at all or withering before maturing. If

[1] Bul. No. 1, Bureau of Plant Industry, U. S. Dept. Agr., "The relation of lime and magnesia to plant growth."

the absence of this element is still more marked, normal vegetation soon ceases, the stem becomes shortened, the leaves grow crowded together—small, distorted, and yellow. All of these symptoms, however, may also be produced by other causes, and the probability of these must always be taken into consideration in diagnosing cases of this kind. No other substance can fully take the place of magnesium in plant growth. It occurs in soils, from disintegrating rocks, chiefly as magnesium carbonate and sulphate. In soils where the magnesium content is already too high, or where it exceeds by weight 4 parts of magnesium to 7 parts of lime, magnesium limestones should not be used for lime. Care is to be taken also in applying fertilizers containing magnesium, as in the crude potash salts. If the soils do not contain a large excess of lime it is necessary to add lime at the time fertilizers containing magnesium are added.

FUNCTION OF CALCIUM, OR LIME, IN THE SOIL.

Lack of calcium, or lime, in plant development is first indicated by stunting and the production of small, yellowish leaves. Chlorophyll (leaf-green) bodies do not develop normally, and the starch which they make is with difficulty changed into sugar, possibly owing to the failure of the nucleus of the cell to manufacture diastase, the ferment necessary for transforming starch to sugar in plant nutrition. It used to be thought that the main purpose of calcium was to neutralize free acids developing in the nutrition of the cell, and while it undoubtedly serves this purpose to a large extent, it owes its greatest importance to the fact that it is a necessary constituent of the compounds entering directly into the composition of the nucleus and of chlorophyll bodies, and it can not be replaced for this purpose by any other substance.[1] In the soil lime performs many important mechanical and chemical functions. One of the most important of the latter is the part which it plays in combining acids set free by decompositions in soils. These are brought about through the action of roots and other organisms upon the soil particles, and also by strictly chemical decompositions. If these free acids were not neutralized they would act injuriously to the roots of crops. The presence of lime also favors nitrification in soils. This point will be discussed more in detail farther on.

IMPORTANCE OF POTASSIUM AS A PLANT FOOD.

Potassium, the essential ingredient of potash, is well known to be one of the most important and indispensable of all plant foods. Large quantities of it are required by all crops. Loew estimates that the amount required annually per hectare (2½ acres) of pine forest is 7½ kilos (15.34 pounds); for the same area of wheat field, 37½ kilos (76.74 pounds); clover field, 102 kilos (208.69 pounds); potato field, 125 kilos

[1] Bul. No. 18, Division Vegetable Physiology and Pathology, U. S. Dept. Agr., "The physiological rôle of mineral nutrients," p. 36.

(255.75 pounds). A considerable part of the ash of most plants consists of this material, and though closely related to sodium in its chemical properties, the latter can not replace it in the plant. Plants growing in soils containing more sodium than potassium will nevertheless absorb much more of the potash. One of the first signs of a lack of potash is a decided cessation in growth without other apparent cause of trouble. The plants often have their normal green color, but make very little starch or sugar and almost no protein or nitrogenous matter. Potash plays an important part in the formation of starches and sugars, but its greatest importance is in connection with protein formation, in which it is apparently indispensable. When it is remembered that proteins or the related nitrogenous compounds are the main source of food for the young growing cells, the importance of potassium will be appreciated.

Recent investigations also indicate that potassium is necessary to turgescence, or water pressure, in the cells. This condition is one of the most important physical requirements of growth. The fact that potassium[1] increases water pressure in cells would also indicate that it increases the water-absorbing power of the plant as a whole, thereby increasing its ability to hold more effectually, in times of drought, the water which it has absorbed. It also increases the water-holding power of soils for the same reason, and is, therefore, valuable from this standpoint on droughty soils. On the other hand, it must be avoided on soils naturally heavy and wet for the same reason. It enables herbaceous plants, like tobacco, to resist light frost, probably by increasing the water-holding power of the cells, as above described, thus preventing the excessive withdrawal of water from them by the formation of ice in the intercellular spaces to such an extent as to result in injury. The importance of increasing the water-holding power of the cell exposed to cold will be appreciated when it is understood that in many cases the effects of freezing are the same as those of drought, namely, the water is withdrawn from the cells by the ice forming in the intercellular spaces. This may go on to such an extent that the protoplasm of the cell becomes almost dry. The cell collapses, and when the ice in the intercellular spaces melts, the cells are unable to absorb the water again, not because they were injured by the cold, but simply as the result of becoming too dry. Protoplasm may, on the other hand, be killed outright by cold at a temperature varying with different species of plants, and even with individuals.

A ready supply of potassium also hastens and perfects the maturing of plants, especially the ripening of the wood of fruit and other trees, thus enabling them to better withstand winter cold. A lack of potash is said by Webber[2] to cause in the orange "an excessive growth of

[1] This refers especially to certain salts of potassium.

[2] Yearbook of the Department of Agriculture for 1894.

weak, immature wood, which does not harden up as winter approaches, and is liable to be injured by frost." Webber also calls attention to the fact that many growers believe that potash, at least in the form of sulphate or when derived from tobacco stems, causes the production of excessively sour fruit. It would be important to determine if this is really true. There are good physiological reasons which lead us to expect such a result, not only in the orange, but in plants in general. However, an increase of starch or sugar would also be expected at the same time. The acid juices of plants are, as a rule, disliked by insects and fungi. This may explain why muriate of potash prevents to some extent the ravages of the rust mite on the orange and the injurious action of the rust mite on cotton.

It is possible that potash salts might in this way have an influence also on the intensity of color in flowers and fruits, especially where the intensity depends on the amount of acid present in the cell sap. The importance of varying tones of color is well understood by florists, and the ability to slightly change a shade by the use of fertilizers would be valuable not only to florists, but to fruit growers and other horticulturists. The whole question should receive careful investigation in view of its possible economic bearing on these minor but important matters. Clay soils, especially clay loams, usually contain from 0.5 to 0.8 per cent of potash, lighter loams about 0.3 per cent, and deep sandy soils less than 0.1 per cent, but even this small amount is equivalent to 3,500 pounds to the acre, assuming that an acre of land 1 foot deep weighs 3,500,000 pounds. As a rule, therefore, it is only upon the lighter sandy soils that a lack of potash may be expected. In the use of potassic fertilizers careful attention should be given to their composition. Muriate, or chloride, of potash and the sulphate are examples of common potash fertilizers in use. The former is as a rule cheaper, and for some crops just as good as the sulphate, and should therefore in these cases be used. The sulphate is preferable for certain crops, and when doubt exists is much safer and more satisfactory. This is especially true in the case of tobacco, which requires a proportion in the leaf of about 6 parts of potash to 1 part of chlorine to produce a leaf of good burning quality. Night soil, kainit, and other manures rich in chlorine should not be used for tobacco. The quality of sugar beets and potatoes is also said to be injuriously affected by fertilizers rich in chlorine. Sugar made from beets rich in this element is said not to crystallize readily. However, it is doubtful if it seriously interferes with the more modern methods of sugar purification. Potatoes, when rich in chlorine, are likely to be pasty or soggy. While these conditions are not pathological, and may be quite the reverse, as far as the health of the plant is concerned, still these instances are instructive in showing how the substances absorbed by the roots may affect the commercial value of crops, entirely apart from

the ordinary consideration of yield. There is a rich field open for a careful study of the effect of such elements as chlorine, sodium, and silicon (usually not strictly required in plant nutrition) on the commercial value of plants. While chlorine may be undesirable, and in fact injurious in some cases, on the other hand it improves celery and apparently makes it more resistant to Cercospera (leaf spot), and its value on asparagus and similar crops is well known. It has long been known that common salt is of great value when applied to light soils too rich in nitrogen. In such cases it reduces the excessive vegetative growth of crops, especially wheat, oats, and barley, thus permitting the formation of more grain in proportion to straw and preventing the lodging due to rank growth. English farmers use it on very light lands, especially for wheat, at the rate of 2 to 3 hundredweight per acre, applied usually before the land is plowed. It is said to prevent rank growth, especially in wet seasons, to retain moisture in the soil in seasons of drought, to strengthen and whiten the straw, and to brighten the appearance of the grain. Salt, however, should not be used on soils poor in nitrogen. Storer[1] suggests that the use of salt may be valuable on some of the rich bottom lands of the West. He says:

> On the so-called American Bottom in Illinois, for example, the growth of stalks and straw is said to be enormous in proportion to the yield of grain. Corn stalks grow 10 to 12 feet high, and are sometimes 5 inches in circumference. While at about the height of a man's head they bear a single ear of corn. For all the rank growth of stalks the harvest is hardly 50 bushels of Indian corn or 25 bushels of wheat to the acre. It would be an interesting experiment to try whether salt or any other chlorine compound would in this case bring the stalk production into fit relations with a proper crop of grain.

Storer also calls attention to the experiments of Nessler and others, showing that salt toughens and makes more elastic the leaves of tobacco, flax, and hemp, greatly improving the length and quality of the fiber of the latter. As already pointed out, however, it injures the "burn" of tobacco and can not be used on this crop for that reason. He also quotes from one of the most successful planters of the South, who says that he has used salt on his cotton lands for fifteen years, and that 300 pounds of salt to 200 pounds of plaster are almost a total preventive of rust, making the cotton bear longer in the season, stand drought better, increasing quantity and improving quality of the product. It is doubtless, in part, this beneficial effect of common salt that makes kainit such a popular form of potash on many crops in the South. This observer finds also that it acts equally well on corn, oats, and other grains, and toughens wheat straw so that there is less waste from the ears breaking off when the crop is cut. These observations lead us to think that salt might be valuable on some of the rich nitrogenous lands of the Northwest in preventing the shattering of cereals.

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[1] Agriculture, p. 586.

IS CHLORINE A FOOD?

While it appears that in some cases plants can be grown to maturity without chlorine, a small amount of this element is, as a rule, necessary for even moderately vigorous growth. Besides the relation to growth already suggested, it promotes the solution and movement of starch and the formation of cellulose or fiber. Buckwheat was found by Nobbe to thrive normally in culture solutions without chlorides until the first flowers were formed. Soon after this the tips of the stalks died off, the upper part of the stalk thickened and developed ring-like swellings, the epidermis burst vertically, and the dark-green leaves became brittle, spotted, puffy, and rolled in. No fruit was produced, and the stems were gorged with starch. This observation has been confirmed by other investigators. Where it is desirable to use a fertilizer containing chlorine, chloride (muriate) of potash would probably, in most cases, prove more valuable than common salt (chloride of soda). Many of the valuable qualities of common salt, however, may be due to the sodium rather than the chlorine. The subject needs further investigation, keeping in view changes in the crops, which, though slight, might be of great practical value.[1]

FUNCTION OF PHOSPHORIC ACID IN PLANT GROWTH.

Phosphorus is one of the most important of the mineral food elements. It occurs in all organisms, both plant and animal, as phosphoric-acid compounds. It enters largely into the nutrition of the nucleus of cells; and it should be remembered that the nucleus is the most highly specialized portion of every living cell, and is its controlling center. In the absence of phosphoric acid the nucleus can neither grow nor divide for the production of new cells, and the growth of the plant is therefore at a standstill. Phosphoric acid is also an important constituent of the chlorophyll bodies, or chloroplasts, as they are commonly called, and of the chlorophyll that stains the chloroplasts green. The formation of sugar and starch from the carbon dioxide of the air can be accomplished by plants only when the chloroplasts are present in a cell and are colored by the chlorophyll. The reduction of phosphoric acid below the required amount, besides preventing growth, causes a yellowing of the chlorophyll, as in the case of the lack of iron, lime, or magnesium, thus preventing the manufacture of sugar and starch. In the case of tobacco, the older or lower leaves of the plant are, as a rule, the first to show yellowing as a result of scarcity of phosphoric acid. Even the partly matured leaves may be involved, while the tuft of young leaves at the end of the stems may be of normal color, though of slow growth. Some orange growers, according

[1] For a fuller treatment of this subject, see Storer's Agriculture, from which many of these observations are selected.

to Webber, claim to be able to recognize phosphorus starvation by the appearance of the young leaves. "If these, when they first push out, or while they are still young and tender, present a slightly variegated appearance, mottled with light and dark green, it is claimed that they are suffering from a lack of phosphorus, and that if a liberal application of soluble phosphate is applied this appearance may be checked." A similar mottling or frenching of the young leaves of tobacco, however, can not be cured by the addition of phosphoric acid, and is known to occur in many plants where there is no lack of this element. A decided lack of magnesium, like a lack of phosphoric acid, causes a yellowing, usually involving first the older leaves. Yellowing due, on the other hand, to lack of iron usually shows first in the young leaves, while the older leaves may retain for a long time their normal green color. A lack of nitrogen is usually manifested by much the same symptoms as are produced by lack of phosphoric acid. Chemical investigation has shown that as a plant nears its flowering and fruiting period, phosphoric acid, magnesium, proteins, and carbohydrates pass rapidly into the younger parts of the plant, preparatory to being stored in the seeds or fruits to meet the requirements of rapid growth at these periods. Young plants, and the young parts of plants, may, therefore, live for some time on this reserve supply before they draw to any extent upon the soil. These materials, if scarce in the plant, are even forcibly withdrawn from the lower leaves and the roots when the reserves are used up. The living substance of cells in the lower leaves is dissolved and absorbed after the carbohydrates, the fats, and other reserve foods are gone. The chlorophyll disappears, then the chloroplasts, the nucleus, and the rest of the valuable constituents of the cells are absorbed by the younger parts. The phosphoric acid, proteins, carbohydrates, potash, etc., thus obtained serve to feed the tuft of young leaves for a considerable time.

A similar transfer of valuable food constituents takes place before the fall of leaves in autumn in practically all deciduous trees.

NITROGEN AS A CONSTITUENT OF PLANT FOOD.

Nitrogen is an important constituent both of plant and animal food. It is essential to the formation of albumin and of various constituents of the protoplasm or living substance of the plant. It is absorbed from the soil by the plant largely as nitrates or ammonia. The latter, when very dilute (3 parts by weight in 10,000 parts of air), can in some cases be directly absorbed by foliage. It has been used to some extent in this way by placing carbonate of ammonia on steam pipes in conservatories. If there is more ammonia in the air, however, than the plants can convert into proteins, the protoplasm will be coagulated and growth almost completely checked, or in case of a great excess, the leaves may be killed. An amount not greater than 3 to 4

parts in 10,000 greatly stimulates the development of foliage. thus retarding flowering or fruiting. Ordinarily, the amount of ammonia in the air is too small to be of any importance either as a direct food of plants or as a source of nitrogen for the roots by accumulating in the soil. By far the most important source of nitrogen for most agricultural crops is the nitrates of the soil. The main source of nitrogen in the soil, besides the decay of organic matter, is the fixation of the nitrogen of the atmosphere through the agency of microorganisms. Though about 75 per cént of the volume of the air is nitrogen, it does not become available to ordinary crops, except as it is absorbed by these microorganisms and converted into nitrates or some other higher nitrogen compound. Many varieties of bacteria and fungi have been found which can absorb free nitrogen if they are furnished with carbohydrate food. This is usually derived from decomposing vegetable matter or from living roots or cells. In some cases bacteria and algæ are associated in the process and in others bacteria live on, or in, the roots of more highly developed plants, forming swellings or tubercles on them, as in the Leguminosæ, or clover family. The great importance of this to agriculture is at once apparent, and the study of the conditions favoring the growth of these beneficial microorganisms is of the highest practical value.

EFFECT OF NITROGEN ON GROWTH.

The lack of nitrogen is usually manifested by reduced leaf and stem growth and the tendency to the production of flowers and fruit at a very early period, though the amount of fruit produced is correspondingly small. In this respect the effect of a lack of nitrogen is similar to that of a lack of water. On the other hand, an excess of nitrogen acts like an excess of water, stimulating the production of vegetative growth at the expense of flowers and fruit. In Pl. IV, *1* and *2*, are shown two flowers, some of the petals of which have turned to foliage leaves as a result of too rapid vegetative growth at the time of the development of the flower buds. Such flowers are common, especially in roses and violets. This growth is rich in nitrogenous matter and water, and is very easily injured by unfavorable conditions. It is a well-known fact, for example, that wheat and other cereals have not only soft leaves and weak stems under such conditions, but the plants are more subject to rust and mildew, and various other parasitic diseases. This is true not only of cereals, but practically of all ordinary plants. In culture under glass these conditions can be controlled and remedied, but in the field it is more difficult. The use of salt on soils overrich in nitrogen has already been discussed. Drainage and methods of cultivation also in a measure afford means of check to rapid and succulent growth in wet seasons. Besides these general effects of the lack or excess of nitrogen on growth, attention should be directed to some

FIGS. 1 AND 2. "GREEN FLOWERS" OR "BULLHEADS" OF VIOLET (V. ODORATA VAR. CAMPBELLI) CAUSED BY STIMULATING VEGETATIVE GROWTH AT TIME OF FORMATION OF FLOWER BUDS. FIGS. 3 AND 4. LEAVES OF SAME VARIETY SUFFERING AS SHOWN IN YELLOW MARGIN BY OVERFEEDING WITH WOOD ASHES.

obscure diseases where nitrogen assimilation appears to be involved. Among these may be mentioned mosaic disease of tobacco, winter blight of tomatoes, peach yellows, "die back" of the orange, California vine disease, and mulberry disease of Japan. As already stated, plants obtain most of their nitrogen through the absorption of nitrates by the roots. The dilute solutions pass up through the stem to the leaves, where, through the aid of the chlorophyll, the nitric acid unites with sugars to form the more highly organized nitrogen compounds, amids, and proteids, which serve as food for the growing cells. The young cells can not use the original soil nitrates any more than animals can, so that if anything interferes with the process of proteid organization nitrogen starvation will follow, even in the presence of large quantities of nitrates. For the organization of proteids sugars are required, and sugar can not be produced unless the chloroplasts are in good working order and exposed to light and heat of the proper intensity. The proper mineral nutrients, lime, potash, phosphoric acid, magnesium, iron, etc., must always be present. With insufficient light or heat there is no proteid formation from nitrates, neither is there any in albino leaves or those devoid of chlorophyll. In both of these cases, therefore, nitrates accumulate in the plant. With the renewal of the activity of the chloroplasts the accumulation of nitrates is gradually worked up into proteids, except, of course, in albino leaves, where the chloroplasts may have permanently lost their functional activity. In such cases the cells usually remain comparatively rich in nitrates. It is known from experimental investigation that a large excess in nitrates may in themselves cause a yellowing in the chloroplasts,[1] and thus serve directly to prevent further nitrate assimilation. At first, plants overfed with nitrate of soda or other strong nitrogenous fertilizer become brighter green and grow rapidly, but as the nitrate accumulates in the cells faster than it is used, the leaves begin to turn yellow on the edges and along the vascular bundles, and growth is checked and the plant dies back. This is especially likely to happen in violets and other crops that are not gross feeders. Yellowing and death of the edges of leaves (though not following a stimulated growth) is caused by an overapplication of almost any quickly soluble salt (potash, sodium chloride, etc.). Pl. IV, *3* and *4*, shows the results of overfeeding violets with wood ashes. In the case of the orange, Webber has observed that the disease known as "die back," appears to be greatly favored, if not caused, by excessive fertilization with organic manures rich in nitrogen. It is not known whether nitrogen from mineral fertilizers has the same effect. Webber also observes that on the poor sandy soils of Florida sulphate of ammonia and nitrate of soda stimulate not only vegetative growth of the orange, but the

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[1]See Bul. No. 1, Bureau of Plant Industry, U. S. Dept. Agr., "The relation of lime and magnesia to plant growth."

production of fruit as well, while organic manures are more likely to stimulate vegetative growth at the expense of fruit, the fruit produced with organic nitrogen being coarser, thicker skinned, and of poorer quality than when mineral fertilizers are used. Muck acts in this respect like the organic manures, as might be expected. The latter material often contains iron pyrite, which, when exposed to air, oxidizes to iron sulphate or copperas. The sourness of muck or peat is often due to this.[1] Free sulphuric acid often forms in such cases, especially in the presence of decaying organic matters. The injurious action of muck on plants is often due to these causes rather than to any peculiarity of their nitrogen. Thorough compositing with lime is a remedy for these conditions.

Mr. M. B. Waite has observed that the peach is very sensitive to overfeeding with nitrogen. Trees grown near barnyards shoot out very vigorously at first, but the tissues seem to degenerate rapidly, forming gum pockets and exuding large quantities of gum. The trees suffer from winterkilling, and in extreme cases are often killed outright. An application of nitrate of soda at the rate of 300 pounds per acre in one case changed the ripening time of peaches two weeks. Peaches regularly ripen on the poor knolls and hilltops earlier than in adjacent valleys or pockets a few feet away, where seepage nitrogen affects them. The latter are also more subject to the Monilia fungus. The proximity of an old stable was in one case the cause of the fruit being belated, and while the trees and fruit were larger, the latter was inferior in color and quality. The fruit on the trees moderately supplied with nitrogen was brighter in color, sweeter and finer in texture, and only slightly smaller. In fact, the peach is healthiest and yields the best fruit in soils which for most other crops would be considered deficient in nitrogen. The plum in this respect behaves very much like the peach, especially the Japanese varieties. Two plum trees were given 6 pounds of nitrate soda, strewn in a circle around the trees about equal to the spread of the branches. It was applied in spring, after the growth had started, and while growth was moderately stimulated during the season and they appeared to be all right in the fall, they were killed, root and branch, the following winter, though adjacent trees were entirely unharmed. On account of this sensitiveness to nitrogen, skillful peach and plum growers are always very cautious in the use of nitrogenous fertilizers, especially stable manure.

Nitrates are moderately strong oxidizing agents, that is, they yield up their oxygen readily to substances having a strong affinity for it. It is a curious fact that in many cases an increase of nitrates in a cell, under conditions not favorable to their organization into the higher nitrogen compounds, proteids, etc., is accompanied by an increase of a ferment or enzym, which is also an active oxidizing agent, or rather

[1] Storer, Agriculture, Vol. II, p. 198.

HELIOTYPE CO., BOSTON.

DISTORTION OF TOBACCO FOLIAGE BY MOSAIC DISEASE, CAUSED BY CUTTING BACK, WHICH BRINGS ON MALNUTRITION.

HELIOTYPE CO., BOSTON.

LEAVES FROM PLANT SHOWN IN PLATE V.

SOME OF THE LEAVES ARE SO STARVED THAT ONLY THE MIDRIB DEVELOPED.

a promoter of oxidation processes. The excessive oxidation not only destroys the easily oxidized nitrogen compounds, but also the chlorophyll and the diastase, or starch-dissolving enzym. The normal nutrition of the cell is therefore interfered with, and we thus find starvation in the presence of an excess of food, because the nature of the food compounds present forbids their use directly by the growing cells. When a plant once gets into this diseased condition it is difficult to cure it. Its vitality is weakened, and it becomes the prey of insects and fungi, or may completely starve to death through a kind of indigestion and rapid oxidation. (See Pls. V and VI.) It is impossible to go into a full discussion of this intricate subject here. It will be treated more at length in a special bulletin by the writer on the so-called mosaic disease of tobacco. Much more work needs to be done, however, before the exact explanation of some of these peculiar phenomena can be given. In the use of organic nitrogen, especially fresh organic manures, there is a possible danger of the production of nitrites during decay and fermentation in the absence of a ready supply of oxygen. The acid juice of the roots of plants would convert nitrites into nitrous acid, which would, of course, quickly kill the feeding roots. This may be one reason why fresh manures often act injuriously on crops, especially in soils not well aerated.

RESULTS OF OVERFEEDING PLANTS.

Some of the results of overfeeding with certain elements of plant food have already been mentioned. Attention has also been called to the unbalanced plant foods and their effect on growth; for example, the improper ratio of lime and magnesia, chlorine and potash, etc. There is still to be discussed the question of excess of food in solution. There are certain physical relations between the solutions in the cells of the roots and the soil solution around the roots which must be maintained in order to secure a healthy, vigorous growth. It is sufficient to say here that if the solid matter in solution in a soil exceeds 1 part in 500 parts of water it is nearing a limit beyond which many plants are likely to suffer; the leaves turn yellow on the edges, become spotted, and drop off (Pl. IV, *3* and *4*), or growth is checked, shortened, and compacted; the leaves often become puckered and twisted, owing to the weakened development of the vascular tissue ("veins") as compared with the soft cells of the leaf. The roots and root hairs are also shortened, thickened, and deformed. This refers, of course, to conditions where concentration is not sufficient to kill the roots outright. Sorauer[1] says:

> We must not forget that the kind of soil and manure which is best for a certain species of plant may be much too strong for another one and cause it to sicken.

[1] Physiology of Plants.

Ericaceæ,[1] Myrtaceæ, and many Leguminosæ require a comparatively weak solution of nutritive matter, while highly concentrated solutions are beneficial to Cruciferæ (especially our vegetables), Resedaceæ, Cucurbitaceæ, Chenopodiaceæ, etc.

If we seek for sound guidance from the aspect of the plant as to the amount of concentration which it requires, we may take it as a general rule that plants with leathery leaves, with hard and narrow leaves, and with hard wood require more dilute solutions than those with large, soft, and expanded leaves. The period at which manure is added is also of considerable importance. During the period of leaf formation all plants can do with the greatest amount of nutritive matter.

Plants adapted to alkali soils are in some cases able to live in solutions of alkali salts of high concentration. They are exceptional, however, and one of the great problems of agriculture in the alkali areas of the West and Southwest is on the one hand to determine how to reduce the injurious action of the various alkalis or remove them from the soil, and on the other hand how to increase the natural resistance to alkali of crops for these areas.

Probably the greatest danger of overfeeding is in the culture of plants under glass and in the intensive work of the market gardener and truck grower. The desire to push growth rapidly and secure maximum crops often leads to an overapplication of stimulating fertilizers, usually with disastrous results.

WATER AS A FACTOR IN PLANT GROWTH.

Water as a factor in the growth of plants was discussed in a paper in the Yearbook for 1894, and can here be touched upon only briefly. When water is artificially supplied, as in irrigation or under glass, it can be given in accordance with the needs of the crop. A lack of sufficient water causes a hard, stunted growth, while an excess of water may cause a soft, watery growth, subject to the attacks of various plant and animal parasites and easily injured by subsequent drought. An excess of water in the soil causes the exclusion of air and asphyxiation of the roots, as before described. The periods of greatest water requirements, for most annual plants at least, are during the rapid development of new shoots and leaves, and again at the period of development of flowers and fruit. During the dormant or resting period, which most plants require at some stage of their development, very little water is required, as well as very little food of any kind. Many evergreen plants, if watered during the resting period, drop their leaves, after which, unless the soil is promptly brought to the proper degree of dryness, the feeding roots decay and the plant may die. In the case of bulbous and tuberous plants the natural ripening and resting periods of the bulbs or tubers must be regarded or the bulbs will either rot or

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[1] Ericaceæ, heath family; Myrtaceæ, myrtle family; Leguminosæ, clover family; Cruciferæ, mustard family; Resedaceæ, mignonette family; Cucurbitaceæ, gourd and melon family; Chenopodiaceæ, beet family.

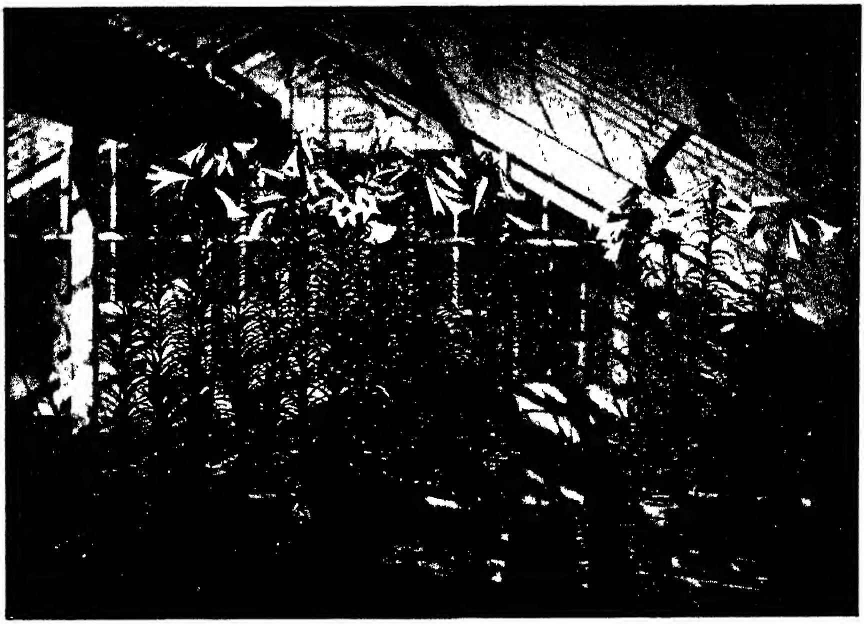

FIG. 1.—SEVENTEEN HEALTHY AND 8 DISEASED PLANTS, FROM 25 MATURE AND RESTED BULBS OF LILIUM HARRISII.

FIG. 2.—NINE HEALTHY AND 16 DISEASED PLANTS, FROM 25 IMMATURE UNRESTED BULBS OF LILIUM HARRISII.

A YOUNG PLANT OF LILIUM HARRISII SUFFERING FROM THE BERMUDA LILY DISEASE.
PLANT GROWN FROM AN IMMATURE, UNRESTED BULB.

produce plants of very low vitality. The so-called Bermuda lily disease was found by the writer to be caused in part by digging the bulbs for shipment before they were ripened and rested and in using unripened and unrested bulbs for stock. By this careless method and disregard of the natural requirements of the plant the lily in Bermuda has become so weakened that only the strictest selection and careful culture can bring it back to a vigorous, healthy condition. Pl. VII, fig. 1, shows the plants raised from 25 mature and rested bulbs and Pl. VII, fig. 2, shows plants from 25 bulbs not fully matured and rested. The original plants from which the bulbs were obtained were carefully selected from the best field that could be found in Bermuda, and were apparently perfectly healthy to start with. Twenty-five of the bulbs were dug before the stems had matured and were kept packed in sawdust in a cool place, as in ordinary storage; the other lot of 25 was allowed to remain in the ground until the stems were fully matured and dried up. They were then dug and shipped to Washington and stored for two weeks, when both lots were planted under the same conditions in the usual way. Both lots of bulbs were perfectly plump and apparently sound when planted, but the unrested bulbs produced 64 per cent diseased and 36 per cent healthy plants, averaging four flowers per plant, while the rested bulbs gave 32 per cent diseased and 68 per cent healthy plants, averaging seven flowers per plant. Pl. VIII shows how the leaves of such weakened plants, as described, die in spots, especially as the result of insect punctures.

Immediately following the period of active vegetative growth and fruit production, most plants store up their reserve food. In perennials it is stored in the roots and stems, and in bulbous and tuberous plants in the bulbs and tubers. Here it undergoes slow changes, varying for different species, preparatory to a renewed period of growth. Many seeds also have to go through a similar resting period in which these nutritive materials become available for further growth. In some cases these changes, during the dormant period, require freezing temperature for normal progress, as in the apple and some other trees, and in some bulbs, like the Lily of the Valley. This is probably owing to the fact that in Northern plants the dormant period is during cold weather, while in tropical plants the dormant period is in dry and hot weather. While plants, bulbs, and seeds may often be forced to grow without their period of rest, it is evident from what has been said that the reserve foods may not be in the right form to properly nourish the early stages of growth, and a weak, diseased plant is the result. No amount of nutritive salts or fertilizers applied to the roots of such plants can help them out. They will eventually starve to death in the presence of an excess of food. The pathological conditions in the cells are the same as described under the head of nitrogen.

ASSIMILATION OF CARBON A CONDITION OF PLANT NUTRITION.

Reference has already been made to the fact that the assimilation of carbon through the absorption of carbon dioxide from the air is one of the fundamental conditions of nutrition. This element forms about half (44 to 60 per cent) of the dry organic matter of both plants and animals. Though the amount in the air is very small, viz, only 0.03 per cent (or 3 volumes in 10,000 volumes of air), the air is the direct source of supply.

The transformation of carbon dioxide into carbohydrates (starch, sugar, etc.) takes place only in cells containing chlorophyll, and these are located, of course, mainly in the leaves. Anything which interferes with the normal development of the chlorophyll bodies in the leaves or the development of their green color (chlorophyll) will of course interfere indirectly with carbon assimilation.

Attention has already been called to various nutritive conditions which do interfere in this way; for example, lack of iron, or the lack or excess of various other salts or nutritive materials, including water.

Heat and light requirements.—It hardly needs to be said that light and heat are also extremely important factors, and that different species of plants vary in regard to their heat and light requirements. In cultivating plants under glass the requirements in regard to intensity of light are controlled by shading or coating the glass with whitewash, clay, or some similar material. The main purpose of this, however, for ordinary crops is not to reduce assimilation, but to prevent too rapid transpiration or evaporation of water from the foliage and too high a temperature of the house, thus preventing wilting. Some plants require less light normally and must be shaded. When leaves are even slightly wilted the stomata, or breathing pores, through which the principal interchange of gases (carbon dioxide, oxygen, etc.) between the leaf and the air takes place, close in order to prevent the further loss of water. In this wilted condition carbon dioxide enters the leaf with difficulty and the sugar production is greatly reduced or altogether prevented.

When leaves are exposed to sunlight, as the writer has determined by experiment, their internal temperature becomes several degrees warmer than the surrounding air. If the external air temperature is very high, tender leaves may get so hot as to be actually scalded. Plants growing in hot deserts and places exposed to powerful sun are, as a rule, covered with a dense coating of hair or scales. This prevents the excessive heating of the tissues and consequent excessive evaporation. It has been observed by some investigators, and confirmed by the writer, that spraying foliage with Bordeaux mixture or lime reduces evaporation. There can hardly be any doubt that these applications act like a covering of hairs or scales in this respect. It is possible that a part of the beneficial influence of Bordeaux mixture in promoting

assimilation, apart from its fungicidal value, is in preventing excessive absorption of heat and light rays by the leaves during hot, dry periods. This would suggest also the use of similar spraying mixtures during droughty hot years for the purpose of reducing the internal tissue temperatures and evaporation from the leaves. Crops so protected might be able to withstand a dry, hot period that would otherwise greatly injure them. It also suggests the inadvisability of spraying heat-loving plants during the cool weather of early spring.

Even when the light intensity is not so great as to cause such extreme injury as just described, it may nevertheless be so strong as to interfere with normal development.

It is as necessary to study the light requirements of crops, especially of plants grown under glass, as it is to study their heat and water requirements. When plants are exposed to too strong light the fact can usually be determined by the effort on the part of the suffering plant to place the surface of its leaves more or less parallel to the light rays, thus reducing absorption. When more light is required, the leaves present their upper surface as nearly as possible at right angles to the light rays, thus increasing light absorption. In very strong light the chloroplasts move to the side walls and turn their edges to the light, and the leaves thus have a lighter green color and less light and heat are absorbed. On the other hand, when the light is weaker, the chloroplasts present their largest surface and the same leaf becomes a darker green and more light is absorbed. If the light is too weak, however, the plant finally becomes yellowish and starved, and various other pathological conditions may develop.

RESERVE FOOD OF PLANTS.

Although it would be of interest to take up in detail the more important elaborated foods, such as starch, sugar, nitrogen compounds, etc., as they are organized by the plant, only a brief general statement can be given here. It is these compounds that the cells draw upon directly for food, as has been already pointed out.

It is well known, of course, that a mature seed of any plant contains not only the embryo plant, but more or less reserve food—starch, sugar, oils, and protein materials. In some cases these materials are directly available to the germinating seedling, even before the complete maturity of the seed. In other cases, after the seed is mature, it has to go through a "resting" period, in which internal changes take place preparatory to germination. Ferments are formed ready to cause the solution of the reserve food during the process of germination. If germination is forced before these changes are complete, a weak and poorly nourished growth is the result. Often these preparatory resting period changes take place only when the seeds are exposed to certain natural conditions of environment, such as heat or cold,

moisture or dryness, etc. These requirements should always be as carefully considered for seeds as for bulbs, tubers, and the resting periods of perennial plants.

During the early stages of growth of herbaceous plants, after the reserve food in seeds or tubers has been used up, the young plant must manufacture its own supply. For this reason the first leaves must begin work early in cases where the reserve food in the cotyledons or other storage tissues is small, and they should therefore be carefully protected against injury. Tobacco is a good example of a plant that has very little reserve food in its seed and has to begin almost at once to look out for itself. This is probably in part the reason why tobacco seedlings grow so slowly at first, and after the production of the second or third minute leaves apparently wait to organize a sufficient amount of reserve food to start off successfully the subsequent rapid development. The young seedlings should therefore not be pushed too rapidly during this early stage of development.

In most plants we have first a root development requiring a warm, moist soil and cool air, then a development of stem and leaves. This is true of seedlings as well as of bulbs and tubers. If during the first stage of development conditions favor leaf instead of root growth, the young plants soon suffer for water and soil food, and even if not killed, may never fully recover from the setback thus received.

The writer has observed that the disease already described as the mosaic disease of tobacco can be induced by stimulating growth in the absence of a sufficient supply of available organized nitrogen compounds (proteins). While the young tobacco plant is making rapid growth after the production of the fourth or fifth leaf, it in many cases contains almost no proteid or sugar reserve. If the roots of such a plant are severely injured, a sufficient supply of nutritive salts and water can not be absorbed to meet the demands of growth, and any existing reserve is quickly used in the formation of new roots.

That many other plants besides tobacco are weakened by similar unfavorable conditions of growth has been observed by the writer and confirmed by other investigators. The amount and nature of reserve food should always be considered in the various operations of propagating and pruning if the health, vigor, and productiveness of the plants operated on are to be kept up to a high standard.

The problem of what fertilizers to use for different crops under varying conditions is a matter of great importance, and would require a special paper for its adequate treatment.

INSECTS AS CARRIERS AND SPREADERS OF DISEASE.

By L. O. Howard, Ph. D.,
Entomologist.

Introduction.

In very many parts of the country the farming population has to contend with at least two diseases which are preventable. These are malaria and typhoid fever. Both of these diseases are transferred or may be transferred by insects—malaria by certain mosquitoes and typhoid fever by the common house fly, or certain other flies.

City and Country Conditions Compared.

While it is true that both malaria and typhoid prevail in large cities, it is none the less true that they may with a certain degree of accuracy be termed country diseases, that is to say, rather specifically, diseases of the farm and the small village. Malaria, in fact, has been called by medical men a country disease. Swampy regions do not occur in cities, or, at all events, only in the suburbs, whereas they occur commonly in the country. Open streams with side pools of still water are found only in the country, and it is in such small, still pools, and in more or less permanent but small accumulations of water, that the malarial mosquito breeds. This mosquito, therefore, does not accommodate itself well to city conditions, but it is found almost everywhere in the country, except possibly in very dry localities and at certain high elevations. Even in dry regions it sometimes abounds, especially where there is a definite rainy season, or where the land is irrigated. Irrigating ditches are prolific breeding places for mosquitoes, including the malarial kind. Malaria in cities, as a rule, is found only with persons who have contracted it in the country or in the suburbs, although with some cities having marshy places on their borders a malarial belt may exist, the extent of which depends upon the direction and force of the prevailing summer breezes, especially the night breezes. For example, such a condition as this accounts for the prevalence of malaria in certain portions of the city of Washington before the reclamation of the Potomac Flats, which lie to the south of the city, the prevailing night breezes of the summer being southern.

SOURCES OF TYPHOID FEVER.

Cities well supplied with water from a reservoir, especially a filter reservoir, which possess a modern sewage system, and in which water-closets are universal, derive typhoid fever only from the following sources: Contaminated country milk, the return of people in the autumn from the less sanitary country, and lack of care in the disposal of the discharges of persons who have contracted typhoid from either of the first two sources.

In the country, however, conditions are different. Each country house or each house in a small village has its own water supply, usually in the shape of a well; the cattle get water from the streams; there are no water-closets, and excreta are deposited in the open or in box privies; drainage from these box privies or from the open deposits containing virulent typhoid germs may enter the streams, be carried for some distance and be taken into the stomachs of cattle all along the course of the stream, or the germs may be carried by underground drainage directly into the wells from which drinking water is gained; or, exposed as these box privies or open deposits are, certain flies may alight upon the excrement and carry the germs directly to the food supply of the houses; or certain flies may breed in this excrement and fly, fairly reeking with disease-bearing filth, to the kitchens and tables of nearby houses. When we consider that active typhoid germs may be given out for some time by persons who have not developed typhoid fever sufficiently so that it may be recognized, and that they may also be given out for some time after patients have been apparently cured of the disease, it is perfectly obvious that in the country the lack of care with which excreta are deposited readily accounts for outbreaks of typhoid fever from any of the causes mentioned.

Methods of Protection from Typhoid and Malaria.

Of course it will be said that the entire water supply of a city may become contaminated at or immediately above its reservoir supply. This contamination is from country sources and might be obviated either in a general manner by the establishment of a reservoir filtering plant, or in a special manner by individual householders by the constant and thorough use of house filters. In cities possessing a common water supply and modern sanitary plumbing there is no excuse for the presence of typhoid in the household. Even the city water must be filtered, which can be done by the use of any one of the cheap filters now on the market; the milk which is drunk by children must be sterilized, and the excreta of persons returning to the city, after contracting typhoid fever in the country, must be disinfected with the utmost care. These three measures, systematically followed, will result in the abolition of typhoid fever within the city boundaries.

So much for cities. In the country the matter is somewhat more difficult, and immunity from malaria and typhoid depends largely upon the individual householder. Such immunity may be obtained, but only as a result of intelligent care.

Let us briefly consider what the farmer or the resident of a small village must do to bring about protection.

MALARIA.

The old idea that malaria is caused by breathing the miasma of swamps has been exploded. Malaria is contracted only through the bites of mosquitoes of the genus Anopheles. The cause of human malaria is the growth and development within the red blood cells of a very minute parasitic organism belonging to the lowest group of the animal kingdom—the group Protozoa, or one-celled animals, which includes those minute creatures known as Amoebas and others, and which live in the water or in damp sand or moss, or inside the bodies of other animals as parasites. This parasite reproduces in the body by subdividing, eventually bursting the red blood cells and entering the blood serum as a mass of spores. Broadly speaking, when the blood of a human being is sucked into the stomach of a mosquito of the genus Anopheles the malarial parasite undergoes a sexual development and gives birth to a large number of minute, spindle-shaped cells, known as blasts, which enter the salivary glands of the insect and are ejected with the poison into the system of the next person bitten by the mosquito. If this person happens to be nonmalarious the malaria has thus entered his system and malarial symptoms result.

So far as present knowledge goes, this is the only way in which people become malarious. In order to avoid this result it is necessary to avoid the bites of malarial mosquitoes, and it therefore becomes important to know the differences between the malarial and the more harmless mosquitoes, and the conditions under which the malarial forms breed.

MALARIA-BEARING MOSQUITOES.

There are very many mosquitoes which have not yet been proven to carry any disease. In fact, the majority of mosquitoes are supposed to be harmless except for the irritation caused by their punctures. The commonest of all forms belong to the genus Culex. These include the mosquitoes most commonly breeding in rain-water barrels and chance transient pools. Fig. 5 shows the difference between a harmless mosquito of the genus Culex and the malarious mosquito of the genus Anopheles. It will be noticed that Culex has clear wings, while Anopheles has wings which are more or less spotted. It will be noticed further that while the palpi (which are the projections either side of the beak) are very short in Culex, they are long—nearly as

long as the beak—in Anopheles. Further, it has been observed that when Culex is resting upon a wall it appears more or less humpbacked, that is to say, the head and the beak are not in the same plane with the body and wings, but project at an angle toward the surface of the wall, the body and wings being parallel with the wall. With Anopheles, however, the head and beak are in practically the same plane with the body, and the body itself is usually placed at an angle with the wall, and especially when resting upon a horizontal wall, such as the ceiling of a room, the body of Anopheles is at a very great angle with the surface. We have in this country three species of the malarial genus Anopheles, namely, *Anopheles maculipennis* (illustrated in fig. 6), *Anopheles punctipennis* (shown in fig. 5, *b*), and *Anopheles crucians* (shown in fig. 7, p. 182). The two former are found nearly all over the country, but the last is a more Southern species, although it has been found as far north as the south shore of Long Island.

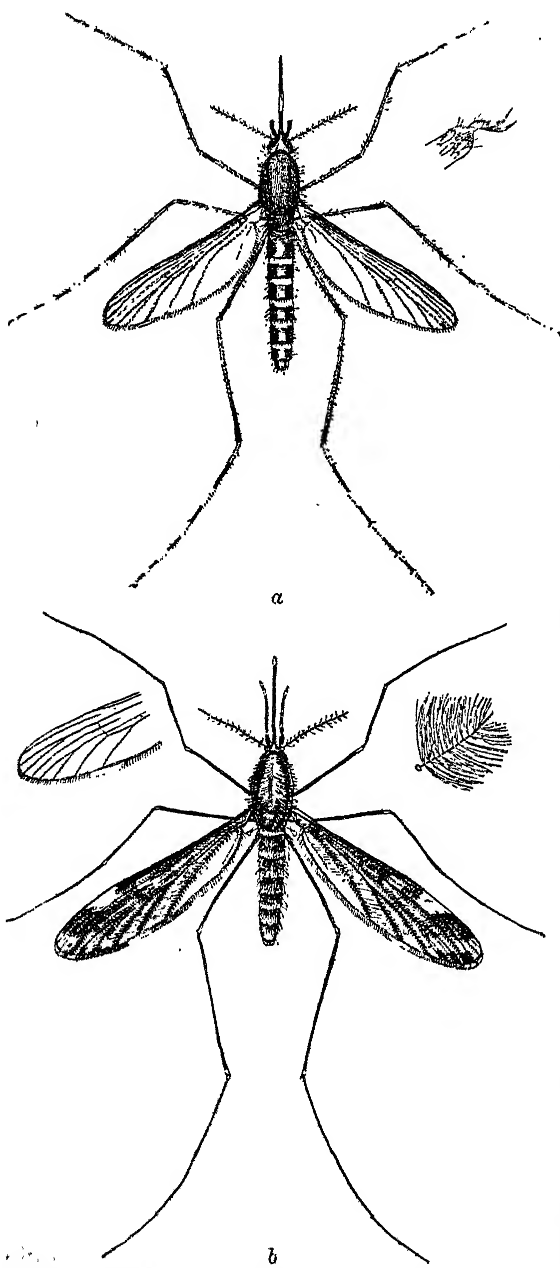

FIG. 5.—Adults of Culex and Anopheles: (*a*) *Culex sollicitans*; (*b*) *Anopheles punctipennis*—enlarged (author's illustration).

As to the early stages, the eggs of Anopheles may at once be distinguished from the eggs of Culex by figs. 8 and 9, those of Culex being laid in the raft-shaped mass on end and those of Anopheles being laid singly upon the surface of the water, always lying upon their sides. The larvæ of Culex, commonly known as wigglers, are familiar to almost everyone, and are the common wigglers found in horse troughs and rain-water barrels, which wriggle around in the water, returning

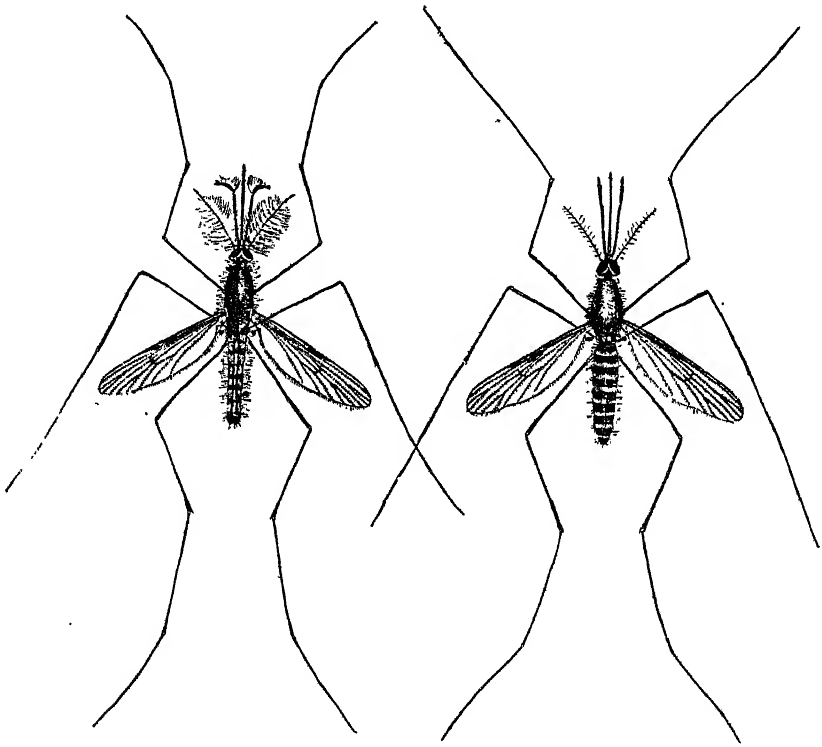

FIG. 6.—*Anopheles maculipennis:* Male at left; female at right—enlarged (author's illustration).

at frequent intervals to the surface to breathe, and when at the surface hanging with simply the tip of the tail extruding, the rest of the body being held below the surface at a great angle. What we have called the "tail" is simply the breathing tube, which, with the common Culex wigglers, is long and more or less pointed. With the malarial mosquitoes, however, the wiggler, or larva, is of somewhat different shape, as shown in figs. 10 and 11, and when resting at the surface, which it does most of the time, it lies with its body parallel with the surface, and not hanging down, as does the Culex wiggler. The pupæ of both forms are shown in fig. 12, and need not be described.

BREEDING PLACES OF MALARIA-BEARING MOSQUITOES.

The breeding places of the harmless mosquitoes are more numerous and more varied than the breeding places of the malarial mosquitoes. Anopheles, however, are found under many divers conditions. They are found, as stated, in still side pools of small streams, in the swampy pools at the margins of larger ponds, in stagnant water in ditches, in the beds of old canals, in the still water at the sides of springs, and occasionally, though rarely, in old horse troughs. They are perhaps more frequently found in such situations as described when a certain

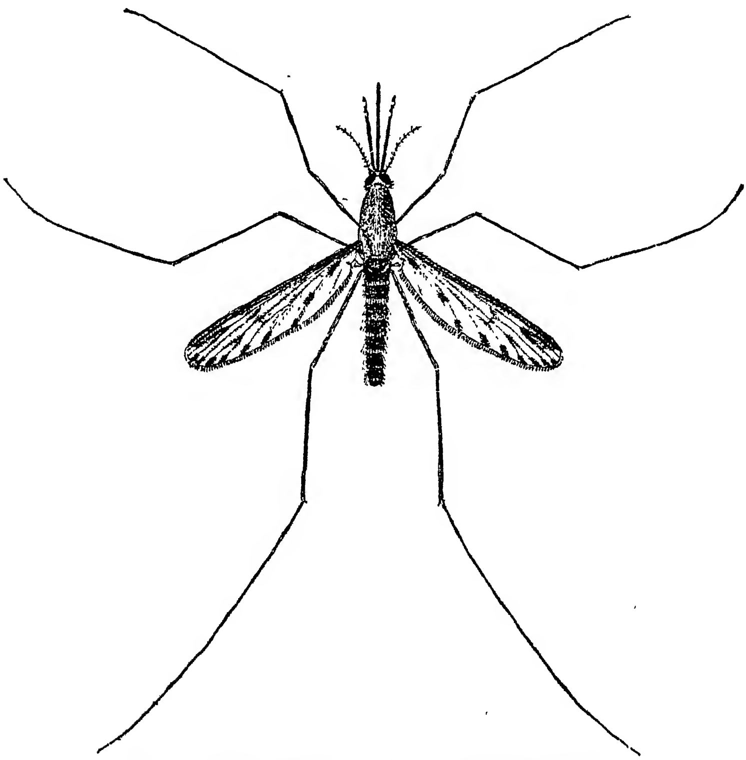

FIG. 7.—*Anopheles crucians*—enlarged (author's illustration).

amount of green scum has accumulated, and it is upon the spores of the water plants constituting this green scum, as well as upon other very small objects floating on the surface of the water, that they principally feed.

MEASURES TO BE TAKEN TO PREVENT MALARIA.

To prevent malarial mosquitoes from breeding in a given vicinity, one should be prepared to recognize their larvæ when they are seen, and to distinguish them from other mosquito larvæ; then a most thorough search for all possible breeding places should be made within

a radius of a mile. This distance is mentioned, since it seems rather definitely proven that the Anopheles mosquitoes do not fly for great distances. After the breeding places are found they should be drained or filled in with earth, or they should be rendered uninhabitable to the Anopheles larvæ by covering the surface of the water with a thin film of kerosene oil, or by introducing certain fish which feed upon the larvæ, such as top minnows, sticklebacks, young sunfish, or goldfish.

Pending the result of such exterminating measures, all houses in malarious localities should be carefully screened to prevent the entrance

FIG. 8.—Eggs of Anopheles—enlarged (author's illustration).

of mosquitoes. After screening, thorough search should be made in the house for mosquitoes which have already gained entrance. Such as are found roosting upon the walls should be captured by placing an inverted vial over them, or they may be stupefied by burning a small amount of pyrethrum powder upon a tin dish cover. Persons wishing to avoid malaria should not sit out of doors exposed to the bites of mosquitoes at night. Persons having malaria should be carefully screened at night to prevent them from being bitten by mosquitoes, which, becoming thus infected, would become potential carriers of the disease. Such patients, systematically treated with quinine, the dose

being always given at the beginning of the chill, will soon be rid of the disease. The time of the dose is important, and the reasons for the time have been abundantly proven by the study of the life of the parasite in the blood cells.

All of this advice is given only after abundant demonstration of the efficacy of the methods. These measures have been followed with success in the most malarious localities in the world, and with this knowledge there is no good reason why an individual should contract malaria in his own home, no matter how much malaria exists around him.

Of course, however, there may be occasions where it is almost impossible to avoid contracting the disease. For example, last October the

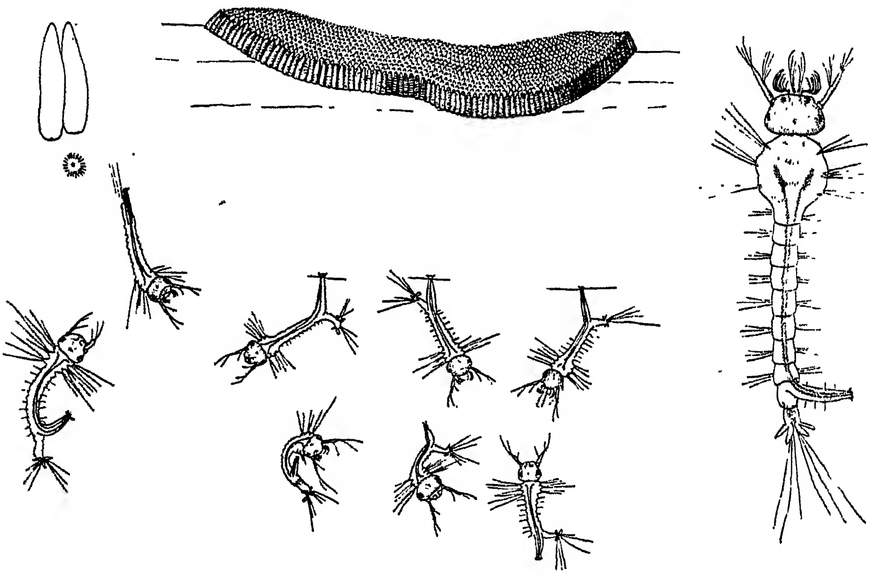

FIG. 9.—Eggs and larvæ of Culex—enlarged (author's illustration).

writer was waiting for a night train one evening in a small Western town where there were irrigating ditches near the station. In these ditches malarial mosquitoes were breeding profusely, and the insects abounded in the station waiting room and on the platform. Nothing but a gauze covering would have kept them away, and several bites were inflicted on the hands and neck. Fortunately, none of the individuals could have bitten a malarial patient, as the disease was not transmitted.

TYPHOID FEVER.

It is not the writer's intention to go further into the causation of this disease than he has already done in his introductory remarks. He wishes, however, to point out as forcibly as possible the danger of its spread by insects and the methods of avoiding this danger.

HOUSE FLIES AND BREEDING PLACES.

The principal insect agent in this spread is the common house fly (fig. 13), and this insect is especially abundant in country houses in the vicinity of stables in which horses are kept. The reason for this is that the preferred food of the larvæ of house flies is horse manure. House flies breed in incredible numbers in a manure pile largely derived from horses. Twelve hundred house flies, and perhaps more, will issue from a pound of horse manure. Ten days completes a generation of house flies in the summer. The number of eggs laid by each female fly averages about 120. Thus, under favorable conditions, the offspring of a single over-wintering house fly may in the course of a summer reach a figure almost beyond belief. With an uncared for pile of horse manure in the vicinity of a house, therefore, flies are sure to swarm. Their number practically will be limited only by breeding opportunities. They are attracted to, and will lay their eggs in, human excrement. Under favorable conditions they will breed, to some extent, in this excrement. They swarm in kitchens and dining rooms where food supplies are exposed. They are found commonly in box privies, which sometimes are not distant from the kitchens and dining rooms. Therefore, with an abundance of flies, with a box privy near by, or with excremental deposits in the neighborhood, and with a perhaps unsuspected or not yet fully developed case of typhoid in the immediate neighborhood, there is no reason why, through the agency of contaminated flies alighting upon food supplies, the disease should not be spread to healthy individuals. That it is so spread is not to be questioned. That under the unusual conditions of the army concentration camps in the summer of 1898 it was so spread to a shocking extent has been demonstrated by the army typhoid fever commission. And the remedy is plain. It consists of two courses of procedure: (1) Proper care of excreta; (2) the destruction of flies.

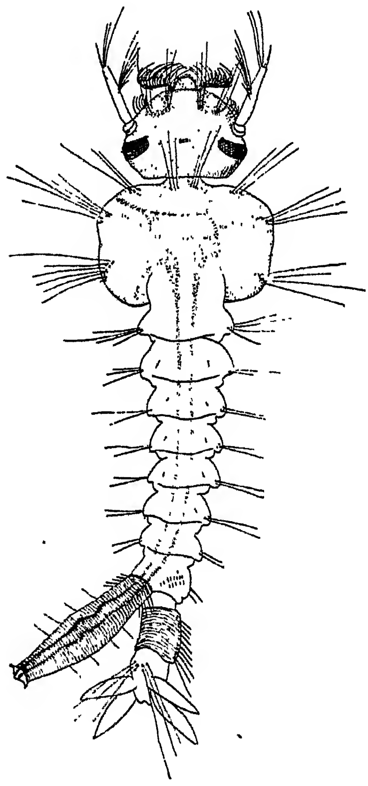

FIG. 10.—Full-grown larva of Culex—enlarged (author's illustration).

MEASURES TO BE TAKEN TO PREVENT TYPHOID FEVER.

On many farms where intelligent people live, the old-fashioned box privy has been done away with, and there has been substituted for it some form of earth closet. Where a good earth closet is in operation. and the inhabitants of a farm appreciate the importance of using no

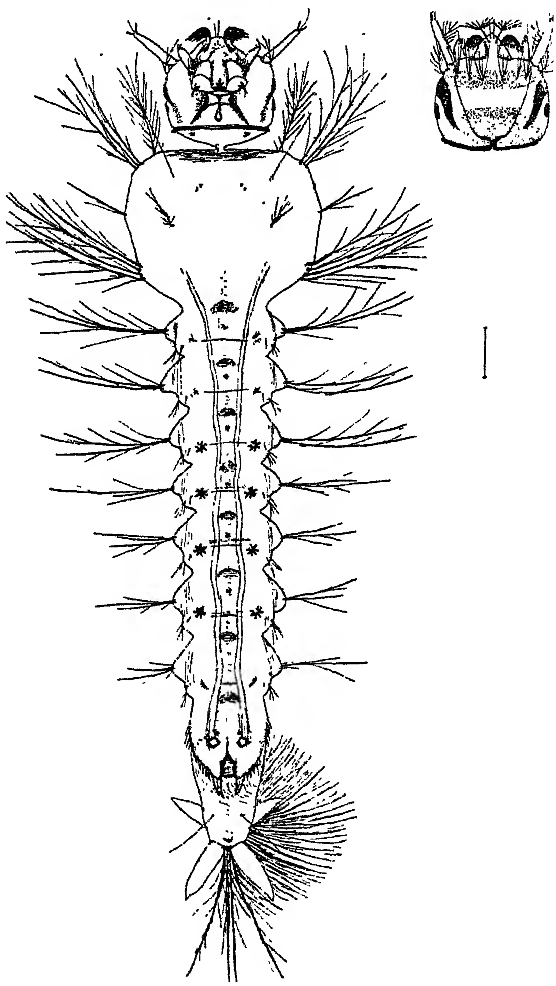

FIG. 11.—Full-grown larva of Anopheles—greatly enlarged (author's illustration).

other, and where in case of illness the excreta of patients are promptly disinfected, flies breeding in the neighborhood will have practically no opportunity to become contaminated with typhoid germs, except in the unlikely event (which future investigation may possibly show) that other animals than man are subject to this disease. The proper

maintenance of an earth closet will add somewhat to the work of a farm, but this extra work will pay in the long run. While it is true that a box inclosure, if its contents are covered with lime every three or four days, will answer the purpose, a much better plan would be to use a large metal vessel, the surface of the contents being covered

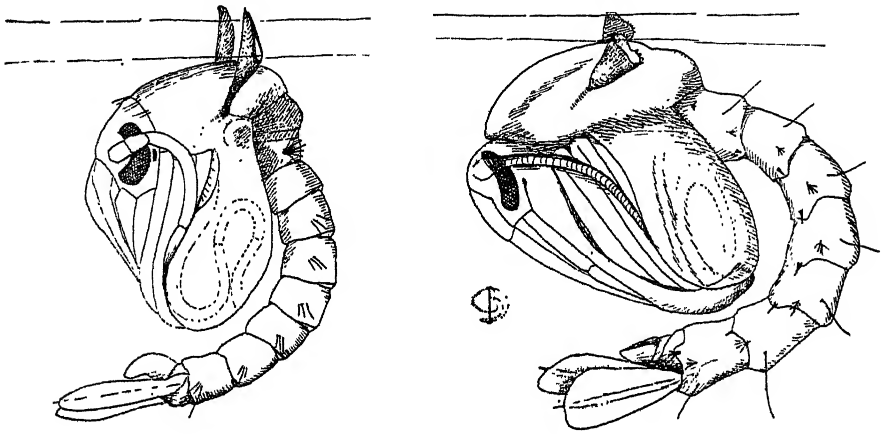

FIG. 12.—Pupa of Culex (at left) and Anopheles (at right)—greatly enlarged (author's illustration).

with earth after each operation, and which may be removed, emptied, and replaced daily. Care should, of course, be taken to empty the contents of the vessel in a pit constructed in some well-chosen spot, from which the drainage would not be dangerous.

With regard to the abolition of flies, the best measures will again

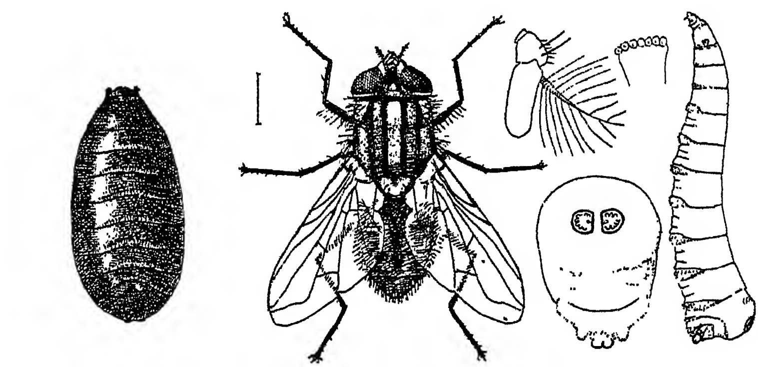

FIG. 13.—Common house fly (*Musca domestica*): Puparium at left; adult next; larva and enlarged parts at right—enlarged (author's illustration).

naturally involve some trouble and expense. In a thickly settled country it will become necessary for some such measure to be generally adopted in order to be perfectly effective, but in an isolated farmhouse the number of house flies may be greatly reduced by individual work. All horse manure accumulating in stables or barns should be

collected, if not daily, at least once a week, and should be placed in either a pit or vault or in a screened inclosure like a closet at the side or end of the stable. This closet should have an outside door from which horse manure can be shoveled when it is needed for manuring purposes. Each day's or each week's accumulations after they are

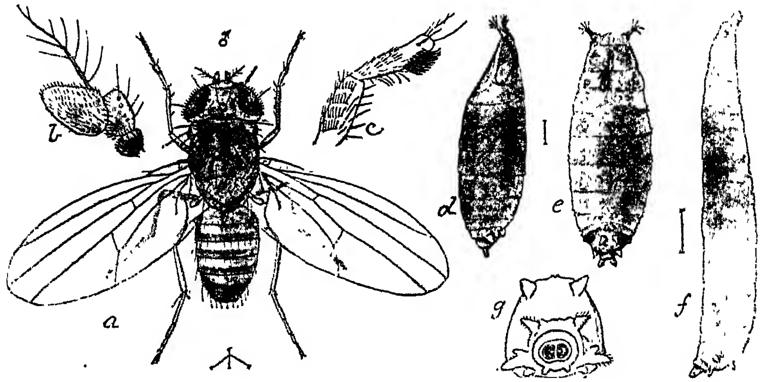

FIG. 14.—*Drosophila ampelophila*: *a*, adult; *b*, antenna of same; *c*, base of tibia and first tarsal joint of same; *d*, puparium, side view; *e*, puparium from above; *f*, full-grown larva; *g*, anal spiracles of same—enlarged (author's illustration).

shoveled into the closet or pit, should be sprinkled over the surface with chloride of lime, and a barrel of this substance can conveniently be kept in the closet. If this plan be adopted (and these recommendations are the result of practical experience), house flies will have almost no chance to breed, and their numbers will be so greatly reduced that they will hardly be noticeable. Many experiments have been made in the treatment of manure piles in order to kill the maggots of the house fly, and the chloride-of-lime treatment has been found to be the cheapest and most efficacious.

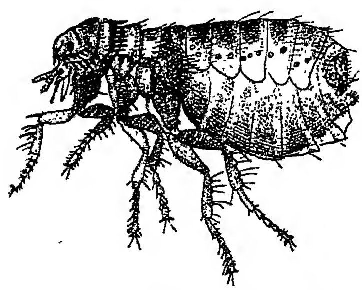

FIG. 15.—Cat and dog flea—enlarged (original).

It has been stated above that the closet for the reception of manure should be made tight to prevent the entrance or exit of flies. A window fitted with a wire screen is not desirable, since the corroding chloride fumes will ruin a wire screen in a few days.

FRUIT FLIES.

While extended investigations have shown that the common house fly is the fly most to be feared in guarding against typhoid, on account

of the fact that over 99 per cent of the flies found in kitchens and dining rooms and attracted to food supplies are house flies, there are a few others which are attracted to and which may breed in human excrement that also have to be guarded against, and as these

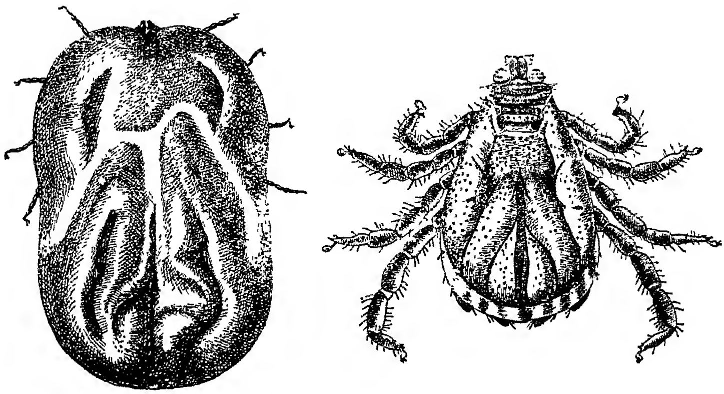

FIG. 16.—Cattle tick—enlarged (redrawn from Salmon and Stiles).

do not breed in horse manure the treatment just described will not be effective against them. The care of human excrement, however, will prevent the carriage of typhoid germs even by these species. The little fruit flies of the genus Drosophila (fig. 14), which breed in over-

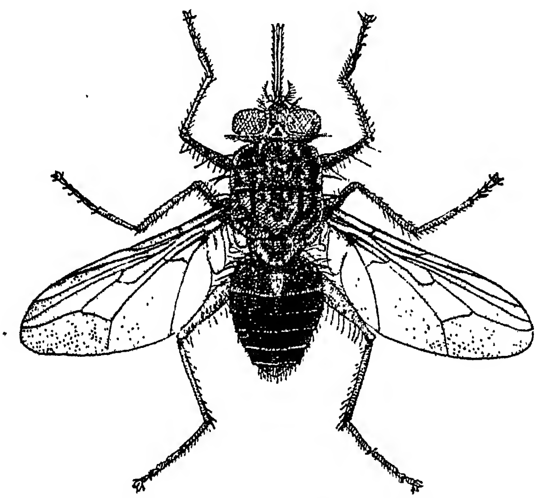

FIG. 17.—Tsetse fly—enlarged (original).

ripe or decaying fruit, are the principal species in this category. Therefore, fruit storehouses or fruit receptacles should be screened and overripe fruit should not be allowed to remain in dining rooms or kitchens for any length of time.

OTHER DISEASES CARRIED BY INSECTS.

While in malaria and typhoid we have the two principal diseases common to the United States which may be conveyed by insects, the agency of these little creatures in the transfer of disease germs is much more widespread in warm countries, and it is by no means confined to human beings. In Egypt and in the Fiji Islands there is a destructive eye disease of human beings the germs of which are carried by the common house fly. In our Southern States an eye disease known as pink eye is carried by certain very minute flies of the genus Hippelates. In certain tropical countries a disease known as filariasis, which somewhat resembles certain forms of leprosy, is transferred among human beings by certain mosquitoes. There is good reason to suppose that the germs of the bubonic plague may be transferred from sick people to healthy people by the bites of fleas (see fig. 15). The so-called Texas fever of cattle is unquestionably transferred by the common cattle tick (see fig. 16), and this was the earliest of the clearly demonstrated cases of the transfer of disease by insects. In Africa a similar disease of cattle is transferred by the bite of the famous biting fly known as the tsetse fly (see fig. 17). The germs of the disease of cattle known as anthrax are carried by gadflies, or horse flies, and when these flies subsequently bite human beings malignant pustule may result (see fig. 18 for one of these gadflies). And other discoveries of this nature are constantly being made. Even the common bedbug (fig. 19) is strongly suspected in this connection.

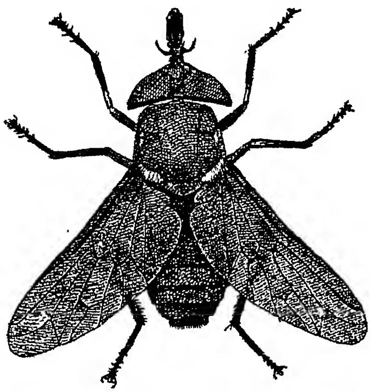

FIG. 18.—Black gadfly—enlarged (original).

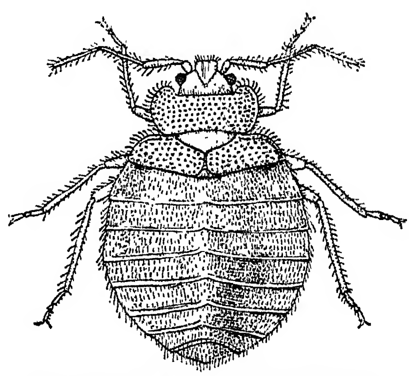

FIG. 19.—Bedbug—enlarged (after Marlatt).

YELLOW FEVER.

One of the most important of these disease-transfer relations of insects which has been demonstrated is the recently proved carriage of yellow fever by certain mosquitoes. The cause of yellow fever has always been a mystery, and indeed it is a mystery to-day in a measure, since although undoubtedly a disease of parasitic origin, the parasitic organism itself has not yet been discovered. During the summer and

autumn of 1900 and spring and summer of 1901 the work of a commission of surgeons of the United States Army has demonstrated in Cuba beyond the slightest possible doubt that yellow fever is not conveyed by infected clothing of yellow-fever patients or by contact with such patients or by proximity to them, but that it is conveyed by the bite of a certain species of mosquito known as *Stegomyia fasciata* (fig. 20), which abounds in regions where yellow fever is possible. The bite of this mosquito, however, does not convey yellow fever to a healthy person until twelve days have elapsed from the time when the same mosquito has bitten a person suffering with the disease. It follows from this fact that by keeping yellow-fever patients screened from the pos-

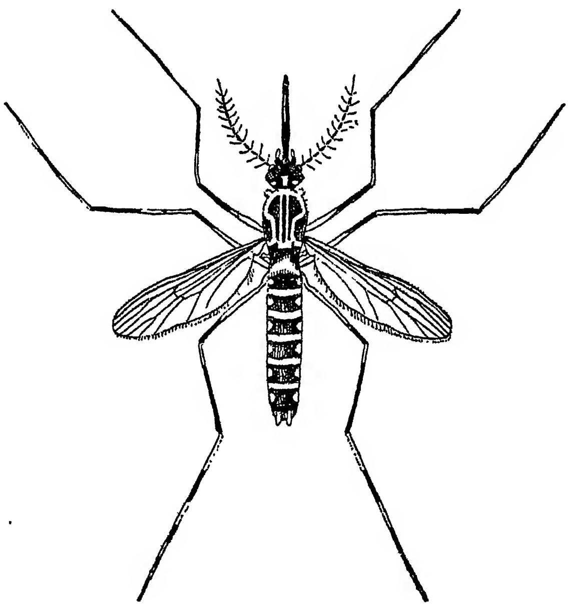

FIG. 20.—*Stegomyia fasciata*—enlarged (author's illustration).

sibilities of mosquito bites we can prevent the yellow-fever mosquito from becoming infected. It follows further that by preventing healthy people from being bitten by mosquitoes we can keep them free from the disease even where infected mosquitoes exist. And it follows still further that by the adoption of remedial measures looking toward the destruction in all stages of the yellow-fever mosquito we may reduce to a minimum the possibilities of the transfer of the disease. After demonstrating the fact, the medical officers of the army in Cuba have put these measures into effect and the results have been most gratifying. The health of Havana has constantly improved, and at the date of present writing the published statement has just been made that during the month of October, 1901, there was not a single case of yellow fever

in Havana, while October is usually the severest month for that disease, and in fact during the past ten years the average number of deaths in the city during that month from yellow fever has been 66.27. This discovery, and this practical demonstration of its truth, it seems must soon change all methods of quarantine in the United States, and it seems certain that in the future the Gulf cities will no longer dread the disease or remain subject to the great vital and economic loss to which they have been subject from occasional yellow-fever outbreaks during past generations.

THE FUTURE DEMAND FOR AMERICAN COTTON.

By J. L. WATKINS,
Cotton Expert, Division of Statistics.

COMPARATIVE USE OF COTTON, WOOL, AND FLAX IN GREAT BRITAIN.

When cotton culture on an extensive scale was first undertaken in this country, wool and flax as a material for clothing were far more popular than cotton, at least in the Western world. For centuries millions of the inhabitants of Oriental countries had been clothed in homespun cotton, and the hand looms of India had woven calicoes and muslins of such beautiful design and exquisite texture as to challenge universal admiration.

But it was not until the planters of the United States began supplying an abundance of raw material, much cheaper than wool or flax, that European nations recognized its merits and its possibilities in textile manufacture. If we go back just a few years beyond the date of the invention of the saw gin (1793), we find that in Great Britain, which then led the world in textile manufactures, wool held the first place in the value of its textile industries, linen the second, and cotton the third. In fact, the value of cotton fabrics and yarns amounted to only about 5 per cent of the whole. Ten years later cotton took the second rank in the value of the textiles exported from Great Britain, but in another ten years it took the lead, and went on steadily gaining ground until it attained the first place, not only in respect of exports, but also in respect of the weight and value of fabrics consumed at home.[1]

A still better illustration of the consumption of cotton, wool, and flax is given by the Textile Recorder, of Manchester, England, in a table showing the relative proportion used in Great Britain. The figures are in millions of pounds, and are the average annual consumption of each fiber in the years named:

Consumption of cotton, wool, and flax in Great Britain.

[In millions of pounds.]

Year.	Cotton.	Wool.	Flax.
1799–1801	41.8	100.6	108.6
1829–1831	248.2	149.2	193.8
1859–1861	1,022.5	260.5	212.0
1869–1871	739.8	312.0	305.3
1879–1881	1,328.4	475.5	248.3
1889–1891	1,604.5	446.6	219.5
1898–1900	1,594.0	496.6	214.7

[1] Ellison's Cotton Trade of Great Britain.

An examination of these figures discloses the fact that a complete revolution has taken place in the consumption of textile fabrics since 1800. More flax was then used than either wool or cotton, but it has now dropped to the third rank, and the amount consumed is barely double that of a hundred years ago. Wool has increased nearly five times, while cotton has increased nearly thirty-nine times, and there is now more than three times as much cotton used as wool, and more than seven times as much as flax.

COMPARATIVE USE OF COTTON, WOOL, AND FLAX IN EUROPE AND IN THE UNITED STATES.

Mulhall[1] says that the factories of Europe and the United States consumed in 1894 nearly four times the weight of fiber used in 1840, the consumption (in tons) of each being as follows:

Cotton, wool, and flax used in factories of Europe and in the United States in 1840 and 1894.

[In tons.]

Year.	Cotton.	Wool.	Flax.	Total.
1840	330,000	340,000	590,000	1,310,000
1894	2,226,000	1,068,000	1,544,000	4,838,000

COMPARISON OF COTTON AND WOOL IN THE WORLD'S COMMERCE.

The figures in the above tables, significant though they are, relate to Great Britain, Europe, and the United States only. As to what is the relative proportion of cotton, wool, and flax consumed the world over, there is no means of knowing, because there are no such statistics available. But we do know approximately the quantity of each fiber that enters into the commerce of the world. As flax is practically out of the race as a successful competitor of cotton and wool, the next question of interest is, How does the competition stand between the latter two fibers? This is best illustrated by showing the total world's supply of each. But in presenting these figures it should be understood that they do not represent the world's production of either cotton or wool, but the supply that enters into the world's commerce. Nor is it necessary to go beyond the year 1870, for it was about that time that cotton production in the United States began to assume something like the importance it held prior to the civil war. The table on the next page gives the figures in decennial years, in thousands of pounds.

[1] Wealth of Nations.

Cotton and wool in the world's commerce in decennial years.

[In thousands of pounds.]

Year.	Cotton.	Wool.
1870	2,483,600	1,295,000
1880	3,605,200	1,626,000
1890	5,228,000	2,456,774
1900	6,796,500	2,685,105

It will be seen that from 1870 to 1880 the commercial supply of cotton increased 45 per cent, while that of wool increased 26 per cent. In the next decade there was a gain of 45 per cent in cotton and 51 per cent in wool. In the last decade, from 1890 to 1900, the gain in cotton was 30 per cent and that in wool only 9 per cent. Taking the entire period of thirty years, from 1870 to 1900, the increase in the supply of cotton was 174 per cent and in that of wool 107 per cent.

FACTORS IN THE INCREASE OF PRODUCTION AND CONSUMPTION OF COTTON.

Having shown the relative position held by the three leading fibers that supply the world with raw material for its clothing, and having noticed the extraordinary expansion in the production and consumption of cotton, the questions naturally occur: To what is it due? Is cotton taking the place of wool and flax and other fibers?

COTTON AS A COMPETITOR OF LINEN.

At the annual meeting of the Belfast Linen Merchants' Association, held at Belfast in 1900 (Belfast is the center of the great linen industry of Great Britain), the president of the association said that he found on looking up the returns of the imports into Belfast that in the year 1880 the imports of cotton yarns amounted to 1,426 tons, and in the year 1899 the amount was 6,271 tons; that if flax spinners would only realize that every pound of cotton meant a corresponding decrease in flax cultivation, it would be more forcibly brought home to them that the efforts which the association had made to secure protection against adulteration of their products were more vital to their interests than anything else. This is a virtual admission that the 6,271 tons of cotton yarns imported into Belfast were used for "adulteration," or mixing with linen, and hence displaced linen yarns to that extent.

The "Decline and fall of the linen shirt" is the very significant title of an editorial that recently appeared in the Irish Textile Journal, a publication devoted to the British linen trade. There was once a time, it says, that the people of Brittany were found to have a linen standard by which the different grades of society could be recognized at sight, and a well-filled linen chest was reckoned as a leading item in family

wealth. But the decay of the linen trade has been rapid enough to be within the remembrance of those still engaged in the business, and leading shirt makers could furnish a deplorable list of influential people who have, to their knowledge, given up buying full linen shirts. According to this authority, the Rothschilds used to order, on occasion, a supply at prices up to 30 shillings a shirt, whereas those now required for the Duke of York, and other royalties, are turned out at Belfast with only fronts and cuffs of linen, the bodies of cotton. This advocate of the linen trade has no fault to find with cotton, "as cotton," but pities the manufacturer for allowing linen to slip off the backs of men without some effort to keep it in its former place.

COTTON AS A COMPETITOR OF WOOL.

In regard to the wool industry, the condition of affairs seems to be even worse than with that of linen. In fact, the situation has become so acute that the wool growers have taken a hand in the struggle, and an organization has been perfected for the purpose of appealing to Congress to enact legislation compelling the manufacturer to brand his goods so as to distinguish cotton-mixed fabrics from all-wool fabrics. Of course, all industries have their periods of depression, the cotton industry as well as others, but that of wool seems to have been undergoing a prolonged depression such as has not affected other branches of trade. This depression is not confined to this country, but extends to Great Britain and the manufacturing districts of France and Germany as well.

In Great Britain many firms have gone out of business, and in France some have changed their machinery to that for the manufacture of cotton.

Various reasons are assigned for this unfortunate state of affairs, such as overproduction, high prices of raw materials, etc., but all authorities agree that one of the principal causes is the competition of cotton. "The use of cotton goods as a substitute for woolens," says the Bulletin of the National Association of Wool Manufacturers (December, 1900), "has been increasing of late years. The advance which the cotton manufacturer has made in the direction of imitating various makes of woolens has been very great in ten years. So also has been the use of cotton in connection with wool. Even with cotton at 10 cents a pound the difference between its cost and that of wool at 50 cents a pound is so great in these days as to encourage the use of more or less cotton in fabrics which will not command prices which allow a fair return provided the material used were all wool." "The extension of woolen mills can not be advanced as a cause of the depression in the woolen and worsted industry," says the Textile World (April, 1901), "for there has been no increase in machinery such as we have seen in the cotton industry; the growth of our woolen and worsted mills has

not kept pace with the growth of the country's population."[1] One of the causes of the trouble, according to this journal, is the increased use of cotton where formerly wool was the material required, the advance in the arts of coloring and designing cotton fabrics having made this substitution of cotton possible.

COTTON AS A COMPETITOR OF SILK.

Noı has cotton spared its opulent and disdainful rival, silk. For a long time it has been known that silk manufacturers have used cotton for mixing with certain kinds of satin and other silk fabrics, but we are now told by a correspondent of the American Cotton and Wool Reporter (Octobeı 24, 1901) that it has become a notorious fact that some of the foreign-made silks are heavily weighted and so mixed with mercerized cotton that it is difficult sometimes to find the silk. Not only is cotton being extensively mixed with silk, but fabrics made from mercerized cotton yarns have entered the markets in competition with a certain class of silk goods. "The manufacture of mercerized cotton fabrics," says the Irish Textile Journal (March, 1900), "has, during the past two years, reached such proportions that these goods have taken apparently a permanent position among the textile standards, and it is reasonable to presume that the position they occupy will be held for many years, or until some other fiber modification will have been discovered that will come closer to silk.[2] At the time mercerized threads were noticed," continues this journal, "the general opinion was that the new article would find only limited application among a few unimportant classes of goods, but as the properties became better known other openings were found, so that to-day there is hardly a fabric where silk is employed but that mercerized cotton can, to a certain extent, displace it—from draperies and hangings, linings, etc.. to neckwear and hosiery."

SOURCES OF SUPPLY OTHER THAN THE UNITED STATES.

So much for the competition of cotton with its three rival fibers, wool, linen, and silk, and the great revolution that has been wrought in the textile industries. And for this revolution, resulting in such a great reduction in the price of clothing, the world is, as we shall presently see, largely indebted to the cotton planters of the United

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[1] The per capita consumption of raw wool in the United States in 1870 was 5.43 pounds, and in 1900, 5.72 pounds, an increase of less than 6 per cent. The per capita consumption of raw cotton in 1870 was 12.82 pounds, and in 1900, 22.57 pounds, an increase of 76 per cent. (Statistical Abstract of the United States.).

[2] The announcement is very recently made that a German chemist has invented a method of making an artificial silk from raw cotton which, it is said, far exceeds the ordinary mercerized cotton. The product, which is manufactured near Aix la Chapelle, is reported to be brilliant in color and finish, of considerable textile strength, and sells for about 60 per cent of the value of real silk. (American Wool and Cotton Reporter, November 7, 1901.)

States. We do not forget the world's indebtedness to that splendid galaxy of English inventors, Hargreaves, Arkwright, Crompton, Cartwright, Watt, and Roberts, and to our own Eli Whitney; nor do we overlook the ceaseless enterprise of British spinners and the indomitable push of British merchants. But while they invented wonderful labor-saving machines, wove their cotton into the best and cheapest of fabrics, and sent them into the remotest markets of the earth, the Southern planter was felling the forests of Alabama, Mississippi, Arkansas, and Texas, opening up new plantations on river side and prairie, and sending to market ever-increasing supplies of the fleecy staple. Nor has there ever been a time, excepting the four years of the civil war, that they did not keep the spinners of the world abundantly supplied with the very best raw material, and at reasonable prices.

COTTON SUPPLY FROM WEST INDIES AND BRAZIL.

About the time of the invention of the saw gin (1793) European spinners obtained their supplies of raw cotton from the West Indies, Turkey (Smyrna), and Brazil.[1] But the chief source of supply was the West Indies, those islands furnishing about 71 per cent, Turkey 20 per cent, and Brazil about 8 per cent. However, the supply from the West Indies began to diminish almost from the date that American cotton assumed importance in the Liverpool market, and by 1816–1820 the contribution from this source amounted to less than 7 per cent of the total supply. After 1836–1840 the supply from the West Indies became insignificant, and has remained so up to the present time, not even the high prices of the civil war stimulating production to any appreciable extent.

The supplies from Brazil gained ground until 1826–1830, but during the subsequent thirty years fell behind, and in 1856–1860 averaged only about the same as in 1816–1820. The civil war increased the crop considerably, but the increase was lost on the return of a lower range of values in 1876–1880.[2] In 1893 the exports from Brazil amounted to 165,000 bales, and in 1900 to only 108,000. During other recent years the exports have been very much smaller (see Table A, p. 200). This is perhaps largely due to the fact that the domestic consumption is increasing, as cotton manufacturing has made considerable progress in that country in recent years.

COTTON SUPPLY FROM EAST INDIES.

As to the contribution of the East Indies to the world's supply of cotton, a country that for a long time was considered a dangerous rival of the United States, Mr. Thomas Ellison, an eminent statistician

[1] It is a somewhat noteworthy coincidence that about this time, or a little prior thereto, cotton in small quantities began to come into the Liverpool market from the United States and the East Indies.

[2] Ellison's Cotton Trade of Great Britain.

of Liverpool, tells us that up to the time of our civil war it was the current opinion, both in England and in India, that the cotton crop of that country was equal to some 5,000,000 to 6,000,000 bales of American weight; some authorities, indeed, went so far as to estimate the yield at 10,000,000 bales. But the fact that the extraordinarily high prices current during the civil war failed to raise the import into Europe to more than 1,374,000 bales against 949,000 in 1861, was a proof that the crop could never at any time have reached one-half of the smallest previous estimates. Mr. Ellison doubted (this was in 1886) whether the crop ever exceeded 2,500,000 bales. The records show that Mr. Ellison was very nearly correct, for, so far as known, the crops of that country, as indicated by the exports and domestic mill consumption, have rarely ever exceeded 3,000,000 bales of 400 pounds, and the average annual crops are far below these figures. Among the noteworthy changes that have taken place in the cotton trade of the East is the decline of the exports of raw cotton from the East Indies. In 1871–1872 the exports to Europe amounted to over 2,000,000 bales of 400 pounds, in 1889–1890 to 1,510,000 bales of 500 pounds (see Table A, p. 200), and in 1900–1901 to only 848,000 bales of 400 pounds. It is a quite noticeable fact that in recent years Italy, Belgium, Austria-Hungary, France, and the United Kingdom have each been taking less and less East Indian cotton. The falling off of imports into the United Kingdom is remarkable. Not very many years ago English spinners consumed over a half million bales,[1] but now the consumption is almost insignificant (see Table C, p. 206). And every pound of East Indian cotton displaced means its replacement by a pound of American cotton of better quality.

To what extent the decline in the exports of cotton from India to Europe is due to the increase in domestic consumption and to exports to Japan (which country has of late largely increased its purchases of Indian cotton), and to what extent it is due to the cheapness and superiority of American cotton, is an interesting subject for investigation. It can only be partially due to increased home consumption, because in some years there have been ample surplus stocks for export. The director-general of statistics to the government of India, in the Review of the Trade of India, a few years ago, attributed this decline to the fall in the price of American cotton caused by unusually large crops, and this explanation seems undoubtedly correct.

COTTON SUPPLY FROM EGYPT.

The cotton supply from Egypt has gradually increased from the date of its introduction in Lower Egypt in 1820, but the great development of cotton culture in that country began with the cotton famine of 1861–1865. In 1860 the Government reduced the export duty from

[1] In 1883 the amount consumed was 404,000 bales and in 1876, 502,000.

10 to 1 per cent, and this also stimulated the culture, and the annual average export for the decade 1861–1870 was 310,000 bales of 400 pounds. Unlike other cotton-growing countries, Egypt did not reduce its production upon the resumption of shipments from America after the civil war, but has steadily increased its output, as shown in Bulletin No. 33, Office of Experiment Stations, U. S. Dept. Agr., "The cotton plant." The exports have increased from 265,000 bales in 1870 to 1,132,000 bales of 500 pounds in 1900. (See Table A.)

But the Egyptian cotton can hardly be considered a rival of the upland staple of America. It is more like our sea-island cotton, although not as fine, and is used for fabrics requiring a smooth finish and silky luster. Moreover, most of it is of a light brownish hue, and among spinners is considered a specialty. Perhaps the best evidence of this lies in the fact that our own spinners annually import large quantities of Egyptian cotton. The imports in 1900–1901 amounted to 69,471 bales of 500 pounds.

UNITED STATES LEADING COUNTRY IN PRODUCTION AND CONSUMPTION.

The extraordinary expansion that has taken place in the cotton industry within the past twenty-five or thirty years, and even within the past ten or twelve years, is well illustrated in the tables, A and B:

A.—*The world's commercial cotton crop, 1860–1901.*

[In thousands of bales of 500 pounds.]

Commercial year.	Crop of the United States.[a]	Imports into Europe from all countries, excepting United States.						Total crop.	Proportion.	
		Brazil.	Egypt.	Turkey, etc.	Peru, West Indies, etc.	East Indies.	Total.		United States.	All other countries.
1860	3,849	38	108	17	18	442	623	4,472	86	14
1865	[b] 522	120	439	191	67	1,053	1,870	2,392	22	78
1870	3,122	174	303	109	63	845	1,494	4,616	68	32
1875	3,832	173	442	70	55	1,136	1,876	5,708	67	33
1880	5,761	63	467	19	26	859	1,434	7,195	80	20
1885	5,706	79	646	52	23	755	1,555	7,261	79	21
1890	7,311	94	631	24	34	1,510	2,293	9,604	76	24
1895	9,901	38	982	36	22	660	1,738	11,639	85	15
1896	7,161	34	974	33	25	853	1,919	9,080	79	21
1897	8,533	48	1,106	26	26	642	1,848	10,381	82	18
1898	10,898	39	1,125	2	36	543	1,745	12,643	86	14
1899	11,189	23	1,243	18	30	607	1,921	13,110	85	15
1900	9,143	108	1,022	49	27	242	1,448	10,591	86	14
1901	10,486	31	1,224	30	23	695	2,003	12,489	84	16

[a] Commercial bales.

[b] Imports into Europe; all other figures for the United States are the actual crops.

B.—*The world's consumption of cotton, 1860–1900.*

[In thousands of bales of 500 pounds.]

Year.	Great Britain.	Continent of Europe.	United States.	India.	All other countries.	Total.
1860	2,091	1,379	807	52	No data.	4,329
1870	2,411	1,570	892	94	No data.	4,967
1875	2,540	1,922	1,155	157	No data.	5,774
1880	2,858	2,365	1,694	297	No data.	7,214
1885	2,903	2,772	1,822	504	No data.	8,001
1890	3,384	3,631	2,367	924	150	10,456
1891	3,181	3,640	2,576	914	160	10,471
1892	2,866	3,692	2,551	918	220	10,247
1893	3,233	3,848	2,264	959	250	10,554
1894	3,250	4,030	2,743	1,074	300	11,397
1895	3,276	4,160	2,572	1,105	419	11,532
1896	3,224	4,368	2,738	1,004	546	11,880
1897	3,432	4,628	2,962	1,141	726	12,889
1898	3,519	4,784	3,553	1,314	845	14,015
1899	3,334	4,576	3,856	1,140	867	13,773
1900	3,269	4,576	3,727	1,254	778	13,604

Since 1870 the increased consumption on the Continent, in the United States, and in India has been enormous. It has also been very large in Great Britain, though much less than in the United States and Germany. Indeed, the United States is now the largest cotton-consuming country in the world, having in 1898 taken the lead from Great Britain, which had held the supremacy in the cotton industry for over a century. (See Table B.) Undoubtedly this expansion could never have taken place (outside of India) except for the continually increasing crops of the Southern States. We are supplying the world with more than 85 per cent of the cotton it manufactures into clothing (see Table A), and Mr. Ellison declared some years ago, when our crops were very much smaller than now, that the cotton crops of the United States provide the raw material for more than half the calico used by the entire human race, from which he inferred that there was a great deal more nakedness in the world prior to the development of the cotton industry in the South than there is at the present time. Mr. Wu Ting-fang, the Chinese minister to this country, in a recent interview stated that until within the past few years his people made all the material for their own shirts, but owing to the cleverness of American manufacturers, China was being supplied with shirt stuffs superior to its own. Consequently, these goods have crowded out those of China, and not only do the well-to-do, but the poor also, wear American shirtings, and no matter how far you travel into the interior, you will see natives, who never laid eyes on a foreigner, clad in shirting from the United States.

In further illustration of the demand for American cotton, the following figures are presented with the view of showing the comparative

consumption in each foreign country in 1870 and 1900. The figures are in uniform bales of 500 pounds each:

Exports of cotton from the United States in 1870 and 1900.

[In bales of 500 pounds.]

Exports to—	1870.	1900.
Austria-Hungary (for 1871)	4,330	44,919
Belgium	3,452	148,319
Denmark (for 1869)	212	31,990
France	306,293	736,092
Germany	173,552	1,619,173
Italy	14,549	443,951
Netherlands	17,050	74,635
Portugal (for 1871)	346	18,472
Russia	30,341	54,950
Spain	55,409	246,619
Norway and Sweden	13,774	14,773
United Kingdom	1,298,332	2,302,090
All other Europe	1,620	400
Total Europe	1,919,260	5,736,376
British North America	3,122	109,983
Mexico	13,219	18,522
South America	177	219
Japan	....	323,202
All other countries (for 1871)	1,263	12,826
Total	1,937,041	6,201,128

It will be observed that without a single exception every foreign country has increased its consumption of American cotton, and some of them to astonishing proportions. This is true particularly of Germany, Italy, France, Belgium, and Spain. The percentage of increase has not been so great in the United Kingdom, but within the thirty years it amounts to 77 per cent, and, considering the magnitude of its spinning industries, this is gratifying enough. But the most astonishing development of our trade in raw cotton has taken place in the Far East. In 1870 we did not ship a pound of cotton to that part of the world, but since then cotton manufacturing has made such progress in Japan that in 1900 her spinners took 323,202 bales of American cotton. East India and China are also beginning to appreciate the merits of our cotton, and within the past four years shipments have been made to both of these countries.

Much has been said about the increase in the culture of cotton in Asiatic Russia and the consequent falling off in the exports of American cotton to that country; and it is true that we formerly exported directly to Russian ports some 300,000 bales per annum. But in spite of the fact that in July, 1900, the Russian Government raised the import

duty on raw cotton to $28.87 per bale of 500 pounds, or almost the value of the cotton, we still furnish that country with about half the cotton used in her mills. The exports, as shown by the United States Treasury Department, do not indicate this, for the reason that Russian spinners for some cause or other prefer to buy their supplies of American cotton from Liverpool brokers. Besides the shipments from Liverpool by water,[1] Government statistics[2] show that in 1900 there were imported into the Empire by overland routes, via Alexandrova, Sosnovice, Wirballen, Mlavo, and Graievo, 109,615 bales of cotton of 500 pounds, nearly, if not quite, all of which was grown in the United States.

THE INCREASE IN THE WORLD'S CONSUMPTION OF COTTON.

The consumption of cotton has increased so greatly within the past quarter of a century that there would appear to be no limit to its future possibilities. It is estimated that of the world's population of 1,500,000,000, about 500,000,000 regularly wear clothes, about 750,000,000 are partially clothed, and 250,000,000 habitually go almost naked, and that to clothe the entire population of the world would require 42,000,000 bales of 500 pounds each.[3] It therefore seems more than likely that the cotton industry will go on expanding until the whole of the inhabited earth is clothed with the products of its looms. This is not an unreasonable conclusion when we consider the fact that cotton is the cheapest material for clothing known to man. In the meantime it may come to pass that the world's area suitable for cotton culture may have to be seriously reckoned with, just as was the case during the civil war.

EFFORT TO DISCOVER NEW SOURCES OF COTTON SUPPLY.

We are told by Mr. Ellison that for some years prior to the outbreak of the civil war it had been foreseen that sooner or later a serious labor disturbance at the South was inevitable, and in view of the calamity which such an event would bring upon English spinners, every effort was made to discover new sources of cotton supply. But although the powerful association formed for the promotion of this end searched every nook and corner of the cotton zone, and sent seed to every one in the four continents willing to make experiments, they entirely failed to accomplish the object they had in view. The high prices caused by the "famine" brought increased supplies from Brazil, Turkey, India, and China, but with the return of ante-war values the

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[1] In 1900 the exports from Great Britain to Russia amounted to 200,410 bales of 500 pounds, most of which was American.

[2] Commerce and Navigation of the Russian Empire.

[3] Report of the Industrial Commission, Vol. VI.

imports into Europe fell back almost to the level at which they stood in 1860–1861,[1] and with the exception of Egypt there has been no substantial increase in the supplies from any country since 1865; hence European spinners are to-day more than ever dependent upon the planters of the United States.

COMPETITORS OF THE UNITED STATES IN COTTON PRODUCTION.

But when the requirements of the world reach from 35,000,000 to 40,000,000 bales, will the Southern States be equal to the emergency, as they were after the civil war? Will they continue meanwhile to retain supremacy in cotton production? We have every reason to believe that they will. Their most dangerous rivals are India, Russia, Brazil, and Egypt.

INDIA.—India has already been put to the test, and, besides, her own mills are now taking a large and increasing proportion of her crops.[2]

RUSSIA.—Russia is making rapid progress in cotton production in her trans-Caspian provinces, but considerably more than half her mill consumption is still of foreign growth, and it will be a long time before she can become entirely independent of a foreign supply. As for any surplus being marketed from that region, the possibility is too remote to be considered.

BRAZIL.—Cotton culture in Brazil could be greatly extended but for the lack of sufficient labor; moreover, her planters find more profit in coffee culture.

EGYPT.—It is estimated that when the irrigation works now under construction on the Lower Nile are completed a little more than 1,000,000 acres will be reclaimed and brought under cultivation, most of which will be devoted to cotton. This will increase the crop to about 2,000,000 bales of 500 pounds. Even should the entire available area in Upper and Lower Egypt[3] be devoted to cotton, at the present rate of production the crop could not exceed 3,750,000 to 4,000,000 bales of 500 pounds. This is the limit of production in Egypt. Under ordinary conditions (for necessarily a large area must always be planted in grain and other food crops), and after the irrigation works are completed and put in operation, Egypt can not supply the world with more than about 2,000,000 bales of 500 pounds.

AFRICA.—Africa is an inviting field for the growth of cotton, and experiments are being made by the French and Germans in the Soudan,

[1] Cotton Trade of Great Britain.

[2] The average annual consumption is about 1,500,000 bales, or fully one-half the crop.

[3] Estimated, including lands to be reclaimed, at 5,750,000 acres, which is about 1,000,000 acres less than is usually devoted to cotton in Texas.

but on a very small scale, and the English are endeavoring to introduce it in Sierra Leone. But whatever may be the possibilities of growing cotton in this part of the world, it is yet an unsettled wilderness, and it will be many years, perhaps a century or more, before any substantial progress can be made toward the production of cotton on a large scale.

SUPREMACY OF THE UNITED STATES IN FUTURE COTTON PRODUCTION.

Where, then, are the spinners of the world to look for an increase in the supply of raw cotton?

In a letter of recent date, in answer to the inquiry, What are the possibilities of cotton culture in Texas? Governor Sayers says:

> I have to express the opinion that not exceeding one-third, if so much, of the strictly cotton area of Texas is now under cultivation, and that if the assurance could be given that for ten years in succession the price of cotton at the gin would average 8 cents per pound the annual product of the State would within that time reach fully 10,000,000 bales. This is not an exaggerated statement, nor is it based upon the cultivation of cotton exclusively in such area, proper allowance being made for the diversification of crops.

Oklahoma and the Indian Territory are each much larger in area than South Carolina,[1] and this State in 1897 and 1898 produced over 1,000,000 bales of cotton. Under favorable conditions, therefore, these Territories could safely be counted on to supply 2,500,000 bales.

The Atlantic States—Virginia, the Carolinas, Georgia, and Florida—could increase their yield by 1,000,000 bales, and the Gulf States, exclusive of Texas and including Arkansas, Tennessee, and Missouri, could swell their production 1,500,000 bales.

In addition to the above, there are large areas suitable for cotton culture in southern California, Arizona, Nevada, Utah, Kansas, and Kentucky. So that, if the time should come when the spinners of the world require, say, 40,000,000 bales, the United States should be able to supply 25,000,000, or over 60 per cent of the whole, provided, always, that there was a sufficiency of labor and that other conditions were favorable.

We are therefore led to the conclusion that for many years to come the Southern States will continue to hold the supremacy as the producers of the best and cheapest clothing material in the world.

SOURCES OF COTTON RECEIPTS AND PROGRESS OF COTTON CONSUMPTION.

The tables following are introduced to show the sources of receipts of cotton at Liverpool, the greatest cotton market of the world, and

[1] The land surface area of Oklahoma is 38,830 square miles, that of Indian Territory 31,000, and that of South Carolina 30,170.

the progress of cotton consumption since 1790, or about the time of the invention of the cotton gin:

C.—*Imports of raw cotton into Great Britain from various countries.*

[In thousands of pounds.]

Countries.	1870.	1875.	1880.	1885.	1890.	1895.	1900.
United States	716,249	841,333	1,224,282	1,050,546	1,316,757	1,394,797	1,365,299
Egypt	143,710	163,912	152,667	177,516	181,266	284,856	312,449
East Indies	341,537	385,686	207,061	145,130	238,747	51,721	36,832
Brazil	64,235	71,860	24,190	36,070	27,935	13,903	30,292
Peru	....	....	4,995	4,061	7,911	8,288	8,031
Chile	....	....	643	1,560	1,166	376	[a]1,707
Turkey, in Europe and Asia	[b]11,511	[b]5,836	500	1,915	1,096	716	1,134
Venezuela and Colombia	[c]1,767	[c]4,196	6,615	1,204	317	71	669
British West Indies[d]	2,314	663	686	834	578	467	436
Australasia	....	....	494	389	115	137	38
All other countries	55,045	18,866	6,532	7,091	17,608	1,711	3,320
Total	1,339,368	1,492,352	1,628,665	1,425,816	1,798,496	1,757,043	1,760,207

[a] Including the Pacific coast of Patagonia.
[b] Mediterranean, exclusive of Egypt.
[c] Venezuela and Granada.
[d] And British Guiana.

D.—*Consumption of cotton in Great Britain, Continent of Europe, and the United States, 1790–1900.*

[In thousands of bales of 500 pounds each.]

Year.	Proportion.				Per cent.			
	Great Britain.	Continent.	United States.	Total.	Great Britain.	Continent.	United States.	Total.
1790	56	60	4		46.6	50.0	3.4	100
1800	100	80	32		47.2	37.7	15.1	100
1810	196	100	40		58.3	29.8	11.9	100
1820	258	152	64	474	54.4	32.1	13.5	100
1830	495	275	147	917	54.0	30.0	16.0	100
1840	917	506	272	1,695	54.2	29.8	16.0	100
1850	1,176	801	614	2,591	45.4	30.9	23.7	100
1860	2,091	1,379	807	4,277	48.9	32.2	18.9	100
1870	2,411	1,570	892	4,873	49.5	32.2	18.3	100
1880	2,858	2,365	1,694	6,917	41.3	34.2	24.5	100
1890	3,384	3,631	2,367	9,382	36.1	38.7	25.2	100
1900	3,269	4,576	3,727	11,572	28.3	39.5	32.2	100

THE TIMBER RESOURCES OF NEBRASKA.

By William L. Hall,

Superintendent of Tree Planting, Bureau of Forestry.

INTRODUCTION.

In no other State is the ratio of planted to natural timber so close as regards area and usefulness as in Nebraska. The comparatively small area of natural timber and the large area of planted timber bring the two into the unusually close ratio of 1 acre of planted to 8 acres of natural forest. Nearly all the latter is composed of young growth, and its chief interest lies in its rapid extension in area and improvement in quality. What the planted timber lacks in area it makes up by more even distribution throughout the State and more convenient location for a large number of uses.

THE NATURAL TIMBER PRIOR TO SETTLEMENT OF STATE.

The original wooded area of Nebraska is estimated at 2,300 square miles, or only 3 per cent of the State's area. One-half of this timber covered the bluffs of the Missouri River or skirted the streams flowing into it, and one-sixth bordered the tributaries of the Blue River; the remaining portion was found in the canyons and on the bluffs in the western part of the State. The combination of adverse natural conditions, together with fire, held the forest within these limits.

The number of species composing this original growth was limited. Some 56 species were found in the extreme eastern edge of the State, along the Missouri River, but going westward one after another of these disappeared until, in the central part of the State, there were but 13 or 14 species. In the western part the number increased again to 22 or 23.

In quality the original timber of Nebraska was not first class. (See Pl. IX.) The extreme eastern part of the State contributed to the sawmill some hardwoods, such as oak, walnut, and elm; the valleys of the central part a little Cottonwood, and Pine Ridge, near the northwest corner of the State, a considerable portion of Yellow Pine. Excepting the pine, only the timber produced in moist and otherwise favorable places was of good form for lumber. Elsewhere the trees grew too far apart to have good form.

IMPROVEMENT IN THE NATURAL TIMBER SINCE SETTLEMENT OF STATE.

With the settlement of the State came a change in conditions which resulted in a modification of forest growth and distribution. Fires became less frequent, the trampling of buffalo ceased, and domestic animals were confined to fenced inclosures. Freed from these destructive agencies the forest sprang into more vigorous growth, and soon began to encroach upon the adjacent prairie.

This change in forest growth has been closely studied by Dr. Charles E. Bessey, who describes it as follows:

I have been studying the tree areas of eastern Nebraska, and find evidence that they are advancing with a good deal of rapidity. My personal observations have been in so many localities that it is impossible to specify them in detail. * * * They involve most of the counties in eastern Nebraska. In practically every case where one travels up the streams, passing out to the side branches, to the little temporary rills which water the upper basins, the trees are of smaller size and are much younger. It is a very rare occurrence to find large trees near the upper end of a forest belt. I have seen a few such cases, but their rarity is such that one is always surprised when they are found. The general rule is that near the upper limit of the tree area there are many shrubs, and mingled with them many young trees no larger than those which, under cultivation, are known to be not more than 15 to 20 years old. I may cite the following localities from my notes: (1) On the head waters of Oak Creek in Butler County; (2) head waters of the Blue River in Seward and Hamilton counties; (3) head waters of Weeping Water Creek in Cass County; (4) along small streams in the Loup Valley; (5) along the small streams north of the Platte in Sarpy County; (6) head waters of Little Nemaha Creek in Nemaha County.

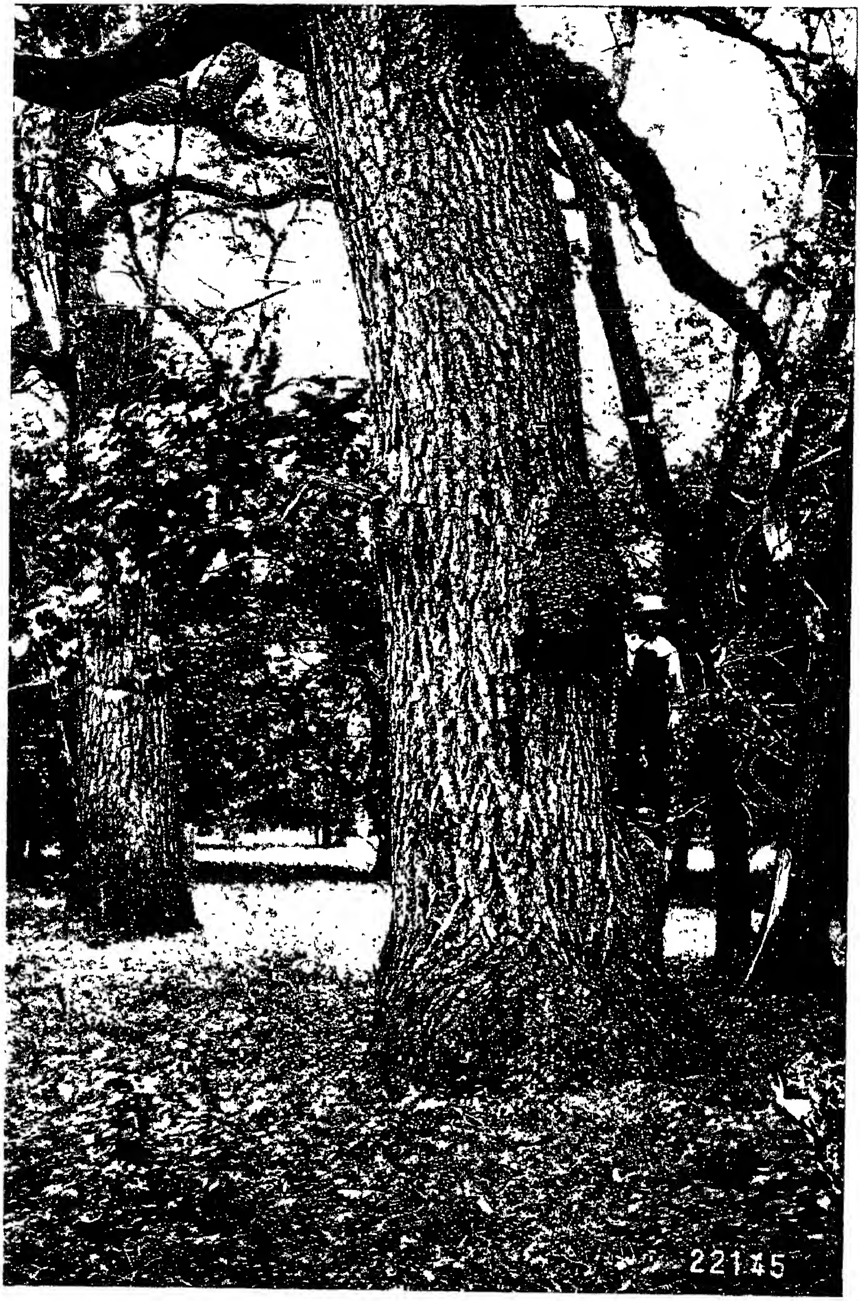
No one who has seen and studied the forest areas in eastern Nebraska will be able to doubt that they are spreading where they are given a fair opportunity and are not prevented by man or his domestic animals.[1]

The improvement in the natural forest is evident in three ways: (1) By extension over new territory; (2) by increase in density in the territory already covered; (3) by improved form of the trees.

GAIN IN AREA.

The extent to which the forest has taken possession of new ground during the half century since settlement began can be estimated only imperfectly. Along almost every stream and ravine the forest has won some ground from the prairie. Here it has been only a few square rods, there several acres. Not infrequently tracts of 80 or 100 acres have changed from prairie to forest. Near the farm of Mr. C. H. Barnard, of Table Rock, a field which twenty-five years ago was without timber and under cultivation is now covered by a dense forest of young timber. In another place, not a mile distant, the forest has extended up a ravine 2 miles beyond its limit of twenty-five years ago. Eastern Nebraska is penetrated by many small streams and ravines, so that the little gained on each one amounts to a great deal in the

[1] Paper read before Section G, Botany, of the American Association for the Advancement of Science, 1899.



TYPE OF ORIGINAL FOREST.

Fig. 1.—Natural Forest on Land under Cultivation Twenty-five Years ago. Pawnee County, Nebr.

Fig. 2.—A Vigorous Young Forest. Brownville, Nebr.

aggregate. It is probably not too much to say that in eastern Nebraska the forest has occupied new ground to the extent of 400 square miles. This is not a net gain in forest area, for it has been partly offset by clearing and pasturage. But with all losses considered the gain has been large. Nor is the growth now confined to streams and ravines as it was once. It appears in every protected place. The following species in that region, the forerunners of larger growth, are coming up in dense thickets along fence rows and roadsides: *Rhus glabra*, *Ribes gracile*, *Rubus occidentalis*, *Symphoricarpus vulgaris*, *Prunus virginiana*, *Cornus asperifolia*, *Rhamnus lanceolata*.

The tendency is for timber to occupy with more or less rapidity all land in the extreme eastern part of Nebraska not devoted to farming and grazing, and the transition is taking place more rapidly now than ever before, because of improved soil and moisture conditions and augmented seed production, due to the increase of bearing trees.

GAIN IN DENSITY.

There has been a gain also in the density of the forest. Originally it consisted of a sparse stand of mature trees with no young growth. (See Pl. X.) The change has been wonderful. With the absence of fires, seedlings grew up densely among the mature trees. Oftener than not the latter were cut out, giving the young timber undisputed possession.[1] An instance of this is to be seen on the farm of Mr. J. O. Lansing, 2 miles west of South Bend. When this farm was purchased, sixteen years ago, all the mature timber had been cut for fuel and posts. The land was fenced and fires excluded, and now there is a dense growth of young timber, all under 20 years old. Nearly all the timber of eastern Nebraska consists of just such vigorous, thick growth under 40 years of age. While it has not reached size for lumber, it is valuable for fuel, posts, and poles. It is probable that the gain in density is even greater than the gain in area.

GAIN IN QUALITY.

The removal of old timber was after all the best course. The mature trees out of the way, the young timber had opportunity to occupy the ground in a dense, even stand. In consequence, its growth is straight and slender; much of it has cleared itself of side branches, and before many years will be of size for saw timber.

The increase and improvement in the natural timber are direct results of settlement and cultivation, and have taken place in the exact ratio with the protection given. Wind, water, birds, and animals

[1] So rapidly were the mature trees cut that in many places the last vestige was removed in a few years. It seemed that the small supply of timber was to be exterminated, for at that time there was no indication of the wonderful reproductive tendency apparent in recent years.

disseminated the seeds from which the trees came, but man protected and encouraged the growth. The natural timber of the present time is, therefore, due almost entirely to his care.

VALUE OF THE NATURAL TIMBER OF NEBRASKA.

The value of the young timber can scarcely be overestimated. Besides its beneficial climatic influence, it has great value on account of the fuel and lumber it will furnish. Its economic value is emphasized by the fact that for the most part it occupies land which, on account of proximity to streams and ravines, is not available for other agricultural crops.

The farm of Hon. J. Sterling Morton, 1 mile west of Nebraska City, affords a notable example of the value of the natural timber under a good system of management. This farm in 1855 included 56 acres of brush land which was of little value for agricultural crops on account of the circuitous course of a small stream which penetrated it. A course of thinning and improvement cutting, at once undertaken and since adhered to, has for forty-five years resulted in an annual product of $200 worth of firewood and posts, or a total sum of $9,000. The cutting and pruning constantly improved the character of the timber. The trees are now better in form, stand, and reproduction than at any previous time, and represent a value of several thousand dollars. (See Pl. XI.)

In many instances the encouragement of the natural timber has paid better than planting.

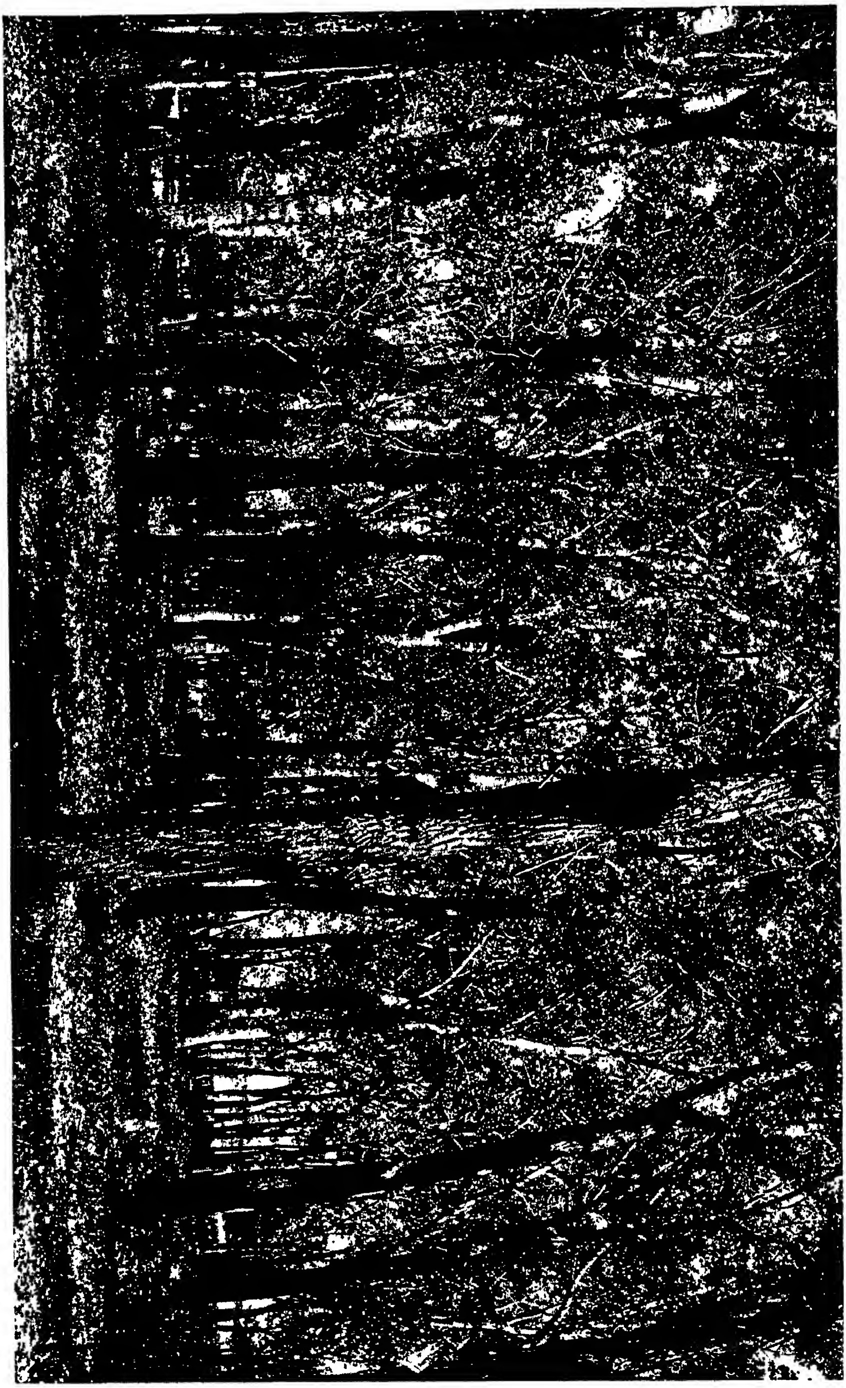
THE PLANTED TIMBER OF NEBRASKA.

Many estimates have been made of the area of the planted timber in Nebraska. Some of these are accurate to a certain degree, but they do not convey a vivid impression of the actual well-planted condition of the State. The fact becomes far more impressive when one passes through the State and observes the almost countless groves on every side. Nearly every farm has its plantations. Even these do not represent the planting actually done, for unfortunately a great deal of it was done wrong, and there is now little or nothing to show for it. Then, in some localities there have been heavy losses on account of adverse conditions of soil and moisture. Yet, in spite of losses, Nebraska has over 200,000 acres of planted timber, and has honestly won the title of "The tree planting State."

While the planted timber is unequal in area to the natural timber, and, as a rule, is inferior to it in thrift and quality, it has had greater influence than the natural timber in changing the appearance of the State from unbroken prairie to a combination of farm and woodland. It has already been pointed out that the natural timber occupies the low land along the streams and ravines. Looking across the country, the natural timber is often entirely hidden from view, or else so

FIG. 1.—NATURAL FOREST GROWTH OF THE LAST FORTY-FIVE YEARS. NEBRASKA CITY, NEBR.

FIG. 2.—YOUNG NATURAL FOREST. NEBRASKA CITY, NEBR.



PLANTATION OF COTTONWOOD.

obscured that its importance is not fully recognized. On the other hand, the planted timber, usually near or about the farmstead, nearly always occupies a commanding situation on the higher slopes or the uplands, where its extent, size, and prominence are considerably magnified. Thus, the casual observer receives his impression almost entirely from the planted timber.

VALUE OF THE PLANTED TIMBER OF NEBRASKA.

GENERAL UTILITY.

The fact that the trees are located in conjunction with the farmstead gives the planted timber distinctive value in several ways. If located advantageously, it serves a very useful purpose in modifying the climate of the farmstead. Climate is the sum total of weather influences. Wind, sunshine, temperature, and atmospheric humidity are important factors. Whatever modifies one of these factors modifies climate. The climate of Nebraska is somewhat rigorous on account of wind and extremes of temperature, so that a regulation of these features by any means is desirable.

The benefits derived from a body of timber planted in connection with the farmstead are principally the following:[*]

Wind protection.—It gives protection from the wind. This is important at all seasons of the year. In summer, by checking the wind, it retards the evaporation of moisture from the soil in gardens, orchards, and near-by fields. In the same way it prevents the loss of fruit and breakage of orchard trees and protects the buildings from the violent gales that occur with great frequency on the plains. In many cases trees alone have saved buildings from destruction by hurricanes.

Its value in winter is equally pronounced. At that time the orchard is so susceptible to injury from high wind that the loss of the fruit crop and even damage to the trees as a result of winter storms are frequent occurrences in the unprotected orchard. Many orchardists regard profitable fruit growing on the plains as dependent almost entirely upon the protection of the trees by wind-breaks. Protection to the buildings and farm animals in winter is also important. Unprotected houses require more fuel than protected ones. Unsheltered live stock of any kind require more feed than those which are sheltered, though the shelter be nothing more than a grove of trees, and, even with increase of feed, unsheltered animals will shrink in flesh during winter storms. Trees, properly located, will prevent many serious losses of this character.

Shade.—Plantations of trees protect the farmstead from the direct sun, which is often extremely disagreeable. One of the most impressive things on the high unsettled prairies in summer is the utter lack

of shade. For miles and miles one may seek in vain for a moment's shelter from the uninterrupted sunshine. Even the grasshoppers seek to protect themselves from the burning heat by creeping into the meager shade of fence posts and tufts of grass.

There are still some dooryards in Nebraska entirely without shade trees; but compared with those which have them, the number is small. The value of shade for the comfort of the dooryard, walks, and drives, and also for the protection of domestic fowls and farm animals, can hardly be overestimated.

FUEL.—The planted timber supplies fuel which is much needed. Nebraska has no coal deposits, and the small area of its natural timber gives an insufficient supply of fuel. Wood and coal must be shipped from the nearest sources of supply, which, for some localities, are 400 or 500 miles distant. Moreover, the high price of wood and coal compels many to economize in their use by substituting other materials, such as corncobs, and, in years of plenty, corn in the ear. But in recent years many farmers have reaped the benefits of previous forethought and labor in obtaining from their planted groves an abundance of fuel for home use. Such saving often amounts to over $100 per year on a single farm.

CONSTRUCTION.—There are many purposes on the farm for which wood materials can be obtained in the plantation. Posts and poles are in constant demand for the building of sheds and fences, forked timbers are often wanted for special uses, and there is continual need of miscellaneous pieces. All such materials play a part in the improvement of the farm and would cost considerable money if they had to be purchased.

It is difficult to estimate in dollars and cents the value of the planted timber from the standpoint of utility, because it is never possible to measure absolutely its benefits. Especially is this true of any region so deficient in natural timber as Nebraska. But could the real value be estimated, it would certainly be high, for the value of anything so influential upon the comfort and economy of the farm is very great.

COMMERCIAL VALUE OF PLANTED TIMBER IN NEBRASKA.

To a certain extent Nebraska farmers regard their plantations from the standpoint of utility, and are unwilling to cut and sell the timber products. However, experience has shown that for purposes such as fence posts, poles, and rough lumber, planted timber can be grown at a profit equal to that from agricultural crops on similar soil.

Cottonwood lumber from planted trees has been used extensively for dimension stuff and inside work in barns and sheds, being considered for such uses fully as durable as pine, while much cheaper. The prevailing price is from $13 to $15 per thousand feet. As indicating the returns to be expected from such an investment, Mr. R. M. Cole,

whose farm is situated 3½ miles southwest of Plattsmouth, has given the results from a 3-acre Cottonwood grove (see Pl. XII) planted in 1860. This grove was planted for general purposes. Its use for wind-break, shade, and ornament has fully repaid for the labor and cost of establishing it. Its commercial value, as represented in the following statement, is to be considered as additional to its utility value:

Results from a 3-acre Cottonwood grove planted in 1860.

Cost:	
Land, at $10 per acre	$30.00
Preparing land for planting	3.00
Seedlings	15.00
Planting	4.50
Four years' cultivation	30.00
Sawing 16,000 feet, at $7.50 per thousand	120.00
Total cost	202.50
Proceeds:	
80 cords wood, at $1.25 net	100.00
16,000 feet lumber, at $13	208.00
15 cords wood from tops, at $1	15.00
50 cords wood still standing, worth $1.25 per cord	62.50
Present value of land, at $60 per acre	180.00
Total proceeds	565.50

RECAPITULATION.

Total proceeds	$565.50
Total cost, exclusive of interest on investment	202.50
Net increase	363.00
Return less increased value of land	213.00
Net annual profit	5.32

The trees were planted 8 by 8 feet, and up to the time of cutting some firewood had been obtained from the broken limbs and dead trees. Use of the land for pasturage, Mr. Cole thinks, would offset the taxes. Part of the lumber was used to build a barn, the rest sold at the price given—$13 per thousand feet.

There are many instances, especially in eastern Nebraska, of Cottonwood trees in general-purpose plantations giving returns equal to or exceeding these when sawn into lumber.

As an illustration of the growth and products of Black Walnut as a planted tree, the grove of Mrs. Kiser, 3 miles southwest of Mynard, Cass County, may be mentioned. The grove, which is about 35 years old, and consists of 8 acres in the form of a shelter belt around the farmstead, was planted originally 8 by 8 feet. On account of thinning and the dying out of some of the trees, the stand has become irregular. The growth is also uneven, owing to inequality of the soil and to the pasturage of part of the grove. One-fourth acre of the

average and a similar area of the best trees were measured, and show the following averages:

Growth and products of Black Walnut, one-half acre.

Age.	Character of growth.	Number of trees.	Diameter breast-high.	Total height.	Length of bole.
Years.			*Inches.*	*Feet.*	*Feet.*
35....	Average, one-fourth acre.	59	9.6	40.9	20.2
35....	Best, one-fourth acre.	60	10.3	58.4	32.2

In the case of average growth, each tree would furnish, on an average, 12 posts, besides some wood. The 59 trees together would furnish 708 posts, worth, at 10 cents each, $70.80, an acreage value of $283.20. In the case of best growth, each tree would furnish 20 posts, with some wood. The entire quarter acre (60 trees) would furnish 1,200 posts, worth $120, giving an acreage value of $480. Enough wood has been cut to pay for the planting and cultivation, and the wood obtained from the remaining trees would pay for cutting the posts. The value of the posts, therefore, would be the net value of the grove. Per acre this value is, for the average part $283.20, and for the best part $480.

For post production other timbers, such as Black Locust, Hardy Catalpa, Red Cedar, Russian Mulberry, and Osage Orange are in many portions of the State more valuable than Black Walnut.

ESTHETIC VALUE OF PLANTED TIMBER IN NEBRASKA.

On account of its high value in general utility and commerce the planted timber of Nebraska has a good influence upon the social well-being of the State. It gives pleasure because it contributes so much to the comfort and prosperity of the people.

Nebraska farmers know that their pleasant home surroundings are largely the result of their own labors. They have changed the wild prairie into productive farms, and in the midst of barrenness have reared comfortable homes and surrounded them with trees, until the whole State is a picture of rural comfort. The beauty of the State, like its resources, has been developed by slow, painstaking work. It is inevitable that after creating so much of their State's value and attractiveness Nebraska people should be alert for its further development.

The planted timber contributes to the social well-being of the people also through the real pleasure it gives them. It benefits young and old alike. The children love the walnuts, the maples, and the elms that stand in their father's dooryard. They sport in their shade and clamber among their branches. Their fancy and aspirations are often stirred by their lofty tops as by nothing else. From the trees themselves more than from books or lectures the children learn the value

of forests. Nebraska children learn from these trees another important lesson. They see in their tree-protected homes the results of long-continued labor, and come to know the close relation that exists between intelligent work and well-being.

But the sense of pleasure and satisfaction from trees is not lost with the passing of childhood. It continues and increases with years. No one in Nebraska more fully enjoys his possessions than the man who can walk among his extensive groves of planted timber with his friends and call their attention to the many interesting facts connected with the growth of the trees and the methods of cultivation. To accompany such a man on a trip of this kind is a real delight.

GOVERNMENT INTEREST IN PLANTING IN NEBRASKA.

Each successful plantation in Nebraska by benefiting one portion has improved the entire region. The Government for this reason is interested in the promotion of individual planting until every landowner shall plant in quantity sufficient for his needs.

In Nebraska the Government has a further duty. In the State it owns 9,798,688 acres of land, the larger body of which centers in the region known as the sand hills.[1] Repeated trials have proved the sand hills unfit for any branch of agriculture except grazing, and for this purpose the sand hills proper do not have a high value. Coincident with the experiments which proved agriculture a failure for the region, other experiments and investigations have shown the natural conditions to be well suited to the growing of timber. Dr. Charles E. Bessey, who studied the region most thoroughly from the botanical standpoint, was one of the first to call attention to the possibility of foresting the sand hills. In his report to the State board of agriculture in 1892, he stated:

> During the year an investigation was made of the region in northern Nebraska known as the sand-hill country, in order to ascertain what native plants grow naturally upon the hills, and in the valleys, with especial reference to their value in supplying forage to domestic animals. The results of this investigation prove to be of unusual interest, showing us that in the sand hills we have a region quite unlike the remainder of the State in many of its physical features. The report made by Mr. J. G. Smith at once suggests the possibility of turning these hills and valleys to some better use than they now serve, and the probability that with some effort they might be covered with profitable forest growth. From all that I have been able to learn of the region, I am led to believe that it is possible to cover large tracts of this country with trees and shrubs, from which a good revenue might eventually be derived.

In the same report L. E. Hicks, geologist of the State board of agriculture, said:

> The foresting of the sand hills, if that shall ever happily be accomplished by combined and persistent effort of individuals, or by a liberal policy on the part of the National and State governments, will add a new artificial condition of considerable importance to the highly favorable natural conditions which already exist.

These opinions are approved by all who have studied the sand-hill

[1] Report of the Commissioner of the General Land Office, 1900.

region from a scientific point of view, as well as by those who have become familiar with its conditions by long residence or experience.[1]

An experiment begun by the Division of Forestry in 1890 has thrown much light on the possibility of foresting the sand hills. In the spring of that year the Division of Forestry sent a large number of pines for planting on one of the worst locations in the sand hills in the southwestern part of Holt County. (See Pl. XIII.) The land being too sandy to admit of plowing, the trees were set in furrows run through the grass, and have remained without cultivation. The plantation contains four species, Scotch, Austrian, Rock (*Pinus ponderosa scopulorum*), and Jack Pine (*P. divaricata*). The Scotch and Austrian pines are now 6 to 8 feet high, the Rock Pine 4 to 6 feet, and the Jack Pine 12 to 18 feet. With the trees now entering upon their period of greatest growth, their thrift indicates complete adaptability to the situation, and unless burned out they will certainly attain suitable size for lumbering. The conclusion forces itself that the species which are adapted to that location will grow on hundreds of thousands of acres in the sand hills where the natural conditions are precisely the same. (See Pl. XIV.)

NEED OF FOREST TREE PLANTING RESERVES.

The situation warrants the establishment by the Government of extensive reserves in the sand-hill region for the growing of timber. On such reserves the work of planting should be speedily begun and carried over those areas best adapted to timber. It should by no means fall short of covering a sufficient area to be self-protective, and if its value is demonstrated to be as great as it is believed it will be, the area should be accordingly extended.

An extensive forest in the sand hills would soon have an immense value to the surrounding region, whether considered for its climatic influence, its products, or its example. It would influence favorably the wind and temperature over a large part of western Nebraska, and by retarding evaporation of moisture from the soil would make the region within and about the reserve more moist than at present. In fifteen or twenty years it would yield a considerable quantity of fuel and posts, in twenty-five or thirty years its timber would be large enough for telegraph poles and railroad ties, and thereafter if properly managed it would be a source of continual revenue.

Moreover, if the Government reclaims its land in the sand hills in this way it will stimulate private owners to plant extensively, and in all probability result in time in the reclamation of the entire 15,000,000 acres comprising the sand-hill region. It will also be a valuable example in dealing with the sand barrens of the Atlantic coast, the Lake States, and other regions of the interior.

[1] P. A. Rydberg, Flora of the Sand Hills of Nebraska, Contributions from U. S. National Herbarium, Vol. III.

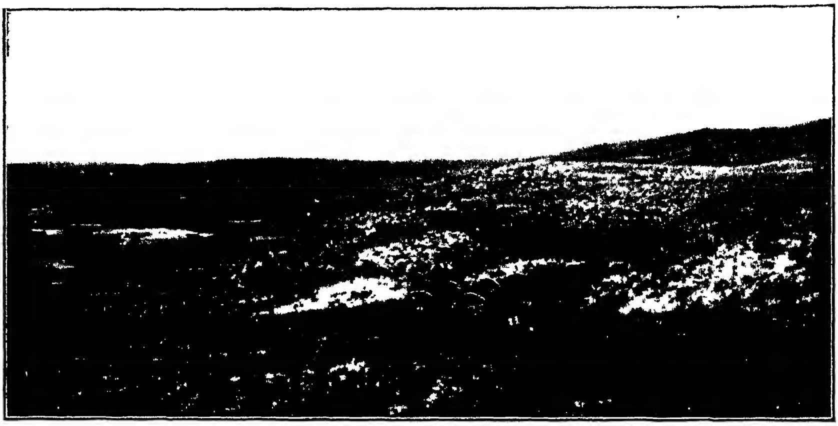


FIG. 1.—THE SAND HILLS.

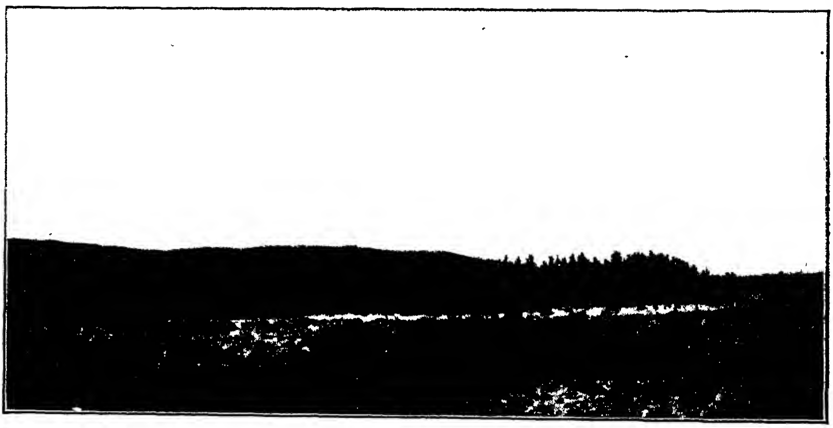


FIG. 2.—PINE PLANTATION IN SAND HILLS, LOOKING NORTH. HOLT COUNTY, NEBR.

FIG. 3.—PINE PLANTATION IN SAND HILLS, LOOKING WEST. HOLT COUNTY, NEBR.

FIG. 1.—YOUNG YELLOW PINE ENCROACHING UPON A SAND HILL. SHERIDAN COUNTY, NEBR.

FIG. 2.—YOUNG PINES ENCROACHING UPON A SAND HILL. DAWES COUNTY, NEBR.

PROGRESS IN PLANT AND ANIMAL BREEDING.

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The ten leading field crops in the United States annually yield nearly $2,000,000,000 worth of plant products. By means of live stock and by manufacturing processes the value of these is so increased before they are consumed that it is very nearly doubled. Experiments have demonstrated that by breeding alone these crops may be so improved in their inherited tendencies as to yield 5 per cent more, even with the cultivation remaining unimproved. Our scientific institutions and breeders have also demonstrated that the animals used to convert large quantities of these crops into concentrated forms of greater worth may also be so improved by breeding as to secure better results from the foods they eat. As science, through the development of machinery and manufacturing processes, has increased the value of raw products, so, by a strict application of the laws of heredity, it promises improved races of plants and animals which will produce larger returns.

There is no reason why Americans may not develop as remarkable ability in originating valuable new varieties of plants and superior new breeds of animals as they have already displayed in inventing machinery and processes of manufacture. Those who have earnestly and intelligently undertaken the improvement of any plant for a period of ten or twenty years, and have observed the past improvement in animal breeding, are unanimous in their belief that 10 per cent additional can be secured in twenty years by a further improvement through plant and animal breeding alone. This would result in ten years in a total increase equal to the value of all the crops grown in one year, representing at least $3,000,000,000 additional wealth to the world. All this could be secured at a cost of less than 1 per cent of its value, or $30,000,000, and the chances are that most of the increased values secured would not cost one-tenth of 1 per cent of their worth.

WHAT BREEDING HAS ACCOMPLISHED.

SOME ACHIEVEMENTS IN PLANT BREEDING.

Examples of past achievement, whether by private plant breeders, by seed firms, or by agencies acting for the State and Nation, make the foregoing statements seem conservative as a basis for action. The sugar in sugar beets was increased more than 100 per cent in the last century by means of rigid selection systematically and scientifically carried out on a large and practical scale by European seed growers.

This work has cost hundreds of thousands of dollars and has earned for the world many millions of dollars of added wealth, which would not have existed but for the breeding of sugar beets by the Vilmorins and others, while millions are yet to accrue.

The farmers of America having been compelled to take in the hand each ear of corn while husking, have annually chosen the largest and best-formed ears from among the many thousands. This has resulted in the most extensive breeding experiment ever carried out, and the yield of corn is probably 20 per cent greater than it would have been without this selection. The farmers of the Northwestern States and of Canada have bred corn, adapting it to regions far north of its former habitat. And Dr. Hopkins, of Illinois, has recently shown that corn may be made still more valuable by breeding it for larger percentages of its most important constituents—protein and oil.

Many thousands of new varieties of potatoes have been originated during the past few centuries, and as a consequence the potato crop has greatly increased in value. Varieties especially bred for large content of starch, to be used in the manufacture of starch and starch products, have recently enhanced the total worth of the potato crop.

The Minnesota experiment station by six years of selection produced varieties of flax 32 inches tall from varieties only 26 inches tall, increasing the length of the fiber more than 20 per cent. This experiment demonstrates the possibilities of breeding flax which will grow as long fiber in a dry climate as is produced from the common flax in Belgium, Ireland, and other moist countries where most of the long fiber is now produced. (See Pl. XV, fig. 1.)

Those acquainted with the achievements of breeders of pansies, chrysanthemums, and violets can not doubt that plants are mobile in their characters, and that from plain forms, under the hand of a master in the art of breeding flowers, most beautiful colors and forms may be evolved. If breeders of field crops and animals can make as pronounced improvements in the growth, yields, and character of plants as have been made by breeders of flowers, their wildest dreams will have been more than realized. De Vries, of Holland, carried common red clover through a process of breeding which has resulted in increasing the leaflets from three up to five and even up to eight in some instances. Garton Brothers, of England, have hybridized various species of forage grasses and made species new to science, and their work with oats, wheat, and other crops is quite as wonderful.

Luther Burbank, of California, has produced results in horticulture which make the figures given above concerning the possibilities of increasing the value of our general field crops seem entirely too conservative. His new varieties are numbered by thousands. By hybridizing the black walnut and the English walnut he produced a new species with fruit very much larger and more valuable than the fruit of either parent, and a more rapid-growing tree. He has also produced

thousands of new plums, many of which are superior to any of the parent varieties.

SOME ACHIEVEMENTS IN ANIMAL BREEDING.

The achievements in animal breeding also include profound structural changes, the full significance of which is not generally recognized. The trotting horse has developed marvelously in his ability to trot. The peculiar value of the blood of "Messenger," the father of the American trotting breed, becomes more and more emphasized, and some of his progeny are in like manner distinguished among their fellows as being prepotent in the production of fast trotters.

The production of the Poland China, the Tamworth, and other breeds of hogs with very distinctive features shows that this species is mobile in the hands of men trained in the science and art of breed formation. Marked achievements have been attained in producing new breeds of sheep; for instance, among the fine and medium wooled breeds from Europe are the Rambouillets, the Horned Dorsets, etc. Cruikshank's subbreed of Shorthorn cattle marked a very substantial improvement, representing to date immense values to professional breeders and to growers of beef cattle.

Some experiment stations have demonstrated the vast difference in the ability of individual cows to produce milk products cheaply from a given amount of food. Some cows do not pay their board; others produce values equal to two or three times the cost of their food; while such animals as the famous Jersey sire, Stoke Pogis, illustrate how an occasional dairy animal has the wonderfully important ability of impressing strong dairy quality upon all his or her progeny.

The breeders of poultry and pet stock have best illustrated the great changes which may be produced in animals as well as in plants. Hunters have trained dogs to "set" and "point"—purely mental instincts bred into the animals as a desirable aid to their masters. Chicken raisers have added to or subtracted from the size, and changed the form, of the wattles of their pets almost at will. Pigeon fanciers have developed from wild species most fantastic forms, producing changes far more profound than that of changing some of the families of beef cattle so as to double their milk-giving capacity without seriously reducing their value for beef production. To add 25 per cent to the lean meat on hogs of a particular breed will not require greater changes in these animals than have been wrought in some varieties of pigeons.

BEST SYSTEMS OF BREEDING YET TO BE IMPROVED.

While many kinds of domesticated plants and animals have been so materially improved by breeding that the wealth of the world and the pleasure of living are greatly increased, only a start has been made in accomplishing that which is possible. The greatest achievements in the few lines illustrate what may be accomplished in the many lines. The extensive application of the scientific business principles of plant

and animal improvement in the breeding of sugar beets, wheat, trotting horses, and dairy cattle illustrate how the same principles, with modifications to suit the species and the purpose, may be applied to improving other species that they may better suit our needs. And the best plans yet may be greatly improved.

The improved breeds of live stock, as we now have them, are of great value to the country, and the use of improved sires should be emphasized everywhere, since, as compared with the common scrub stock of the country, their value can hardly be calculated. These improved breeds form an excellent basis for further improvement. The present plan of herdbook pedigrees, based mainly upon prize getting at fairs, high prices at sales, and racing records, has done great good in America. But better methods of basing pedigrees on performance or other actual measurements of qualities would still further improve breeds and result in there being fewer pedigreed animals deficient either in individuality or in prepotency.

WHAT BREEDING SHOULD ACCOMPLISH.

There is so much in breeding which is interesting and artistic, and which shows on the exterior, sometimes indicative of intrinsic qualities within, that the tendency is for breeders too often to unduly emphasize the form and appearance rather than the substance—to exalt that which is attractive to the eye rather than the qualities of economic value. Too often breeders have assumed that appearances are the qualities to be desired; judges at shows have decided too much on that basis, and purchasers have followed the fashion, believing that exterior perfection meant comprehensive excellence. Qualities which are sought because fashionable, like styles of dress, change with the decree of fashion makers, not only causing the loss of stability, which comes from long continued breeding to a single type for a single purpose, but inducing men to breed for and to use that which looks well rather than that which is truly meritorious.

THE TENDENCY IN ANIMAL BREEDING.

The poultry judge puts 95 per cent of the weight of his score-card points on the comb, wattles, feathers, legs, and other mere clothes of the body, and too often entirely overlooks the thickness of meat, hardiness, size, and prolificacy—qualities that make the breed profitable both to the producer and to the consumer.

Breeders of driving horses, in their efforts to secure the phenomenal race horse, have singled out speed in the short trotting race, too often narrowly ignoring size, stamina on a long drive, and even comeliness and prolificacy. They have assumed that by breeding for the instinct to trot, the form for mere action, the fiber to endure heavy training, and the mental balance to contest the race to a finish, all the other qualities desired in driving horses would be secured. Breeder's too often seek to obtain excellence in a single quality, because results may thus

be earlier reached, ignoring the plain fact that for permanently useful varieties of plants or breeds of animals all the correlated qualities going to make up the desired new sort must be considered and blended. Single-purpose breeding is often visionary, since even the special-purpose dairy cow, the trotting horse, the hardy apple, the wine grape, or the fiber flax must have numerous qualities correlated and blended together into a whole which may be practically reproduced under varied conditions of soil, climate, and care. Thus, the breed of dairy cattle to be the most profitable must have, in addition to a large capacity to consume food and the quality to long sustain a large flow of rich milk, the ability to resist tuberculous and other diseases; it must be prolific in calf bearing; longevity should be a strong characteristic; the animals must have kind dispositions; and all these qualities must be blended as a strongly flowing stream in the heredity of the breed. These qualities must be so prepotent that in upgrading common stock they will predominate in the blood of males used for that purpose.

Breeders of some families of Poland China hogs for decades narrowly chose those males and females which, in response to the abundant corn and clover in the Upper Mississippi Valley, matured early into fat, rectangular animals, thus showing that they came from the germs inheriting a tendency toward the inactive, the indolent, the fat, flabby carcasses, with an unusually small portion of muscle or lean meat. The philosophy of the show ring and of the swine page of the agricultural periodical for a third of a century wrongfully led too exclusively to the selection of these "rectangular" animals, until in some families the results bordered on fatty degeneration. The individual hog was shapely, attractive, and suited the eye of the breeder trained in the art of producing that kind; but fecundity was reduced to one-half, in some families to one-fourth the normal—far below the profitable point for the hog raiser. The ability to resist disease was seriously impaired, and the hog had far more cheap lard and far less valuable lean meat than had the best representatives of the breed thirty years ago, or than have some families of Poland Chinas now, or the average of some of the new breeds which are less refined in the direction of mere larded carcasses.

In the same manner, some families of Shorthorn cattle have been bred to the extreme standards of the fat animal prepared for the show ring. This has resulted in part because they have been in competition at shows with the special-purpose beef breeds until they have unfortunately lost nearly all their valuable milk-giving qualities, and no longer well serve the general farmer for a general-purpose breed of cattle, as do the families of so-called milking Shorthorns. In the hurry to reach a specific result, our breeders often are too narrow to breed from the best all-round animal, which is desired on more farms than either the highly specialized beef animal or the more highly specialized dairy animal.

THE TENDENCY IN PLANT BREEDING.

Likewise, in plant breeding, the tendency has too often been to try to attain excellence by indirect methods, neither comprehensive nor based on definite knowledge. On the one hand, the farmer tried to breed wheat with the fanning mill, while on the other hand some plant breeders' efforts were to secure hybrids—new merely in appearance. The effort here should be to secure the blood lines[1] of individual plants, which, when multiplied into varieties, will combine large yields with the qualities of flour to make fine bread, superior in nutritive quality. The plan must include the elimination of the many so as to retain only the very few large yielders, and the final tests of resultant varieties must be comprehensive and rigid. Advertisements of showy appearance may sell a new wheat, but to attain the high distinction of really becoming and remaining one of the very few commercial wheats found in any State, a new variety must have the ability to yield a greater value per acre. A new variety whose inheritance and prepotency add 10 per cent increase to every acre has such an enormous value that we can well afford to expend large sums of money to devise and carry out the best plan of breeding for securing it.

DEFINITE RESULTS IN PLANT BREEDING POSSIBLE.

With definite ideas in mind the breeder could produce definite results, as suggested by the following examples:

SUGAR BEETS are an instance in which we depend almost wholly on European seed breeders and growers for our seeds. Those Europeans well acquainted with the production of sugar-beet seed realize that if Americans would breed sugar beets in each State where this crop is grown as carefully as is done in Europe our farmers would raise more sugar per acre. In our drier climate beets with a tendency to grow large could be used to greater advantage than in Europe, where the roots must be kept smaller to secure sufficient richness of juice. And since manufacturing processes have been improved less attention need be given to purity of juice, the great problem being to increase the yield of sugar per acre. In addition to the loss from paying for freight on seeds, for European labor, and for European rentals, we do not have varieties of sugar beets so well suited to our needs as could be produced under a proper system on our own farms in the very regions for which the seeds should be bred.

TIMOTHY may be improved by selection and by hybridization followed by selection, yet we have supinely accepted the single variety of this plant as nature gave it to us. Suppose we had done the same with the potato. Yet, the crop of timothy represents more value annually on most of our farms than does the potato crop. We ought to have varieties of timothy especially adapted to producing larger quantities of more nutritious hay, with a larger percentage of leaves and a

[1] The term "blood lines" is used in the same sense in plant as in animal breeding.

higher percentage content of nitrogen; also varieties superior for permanent pastures. and other varieties suited for both pasture and hay.

FIELD PEAS should be so improved by breeding that they will better withstand the dry, hot weather west and southwest of the Great Lakes, that they may there serve as an annual crop to add nitrogen to the soil and to supply animal rations with more protein.

SOY BEANS should be bred so as to mature earlier at the North, and the early sorts should be bred to yield more per acre, and to have even a higher percentage content of nitrogen.

RED CLOVER should be bred to more hardy forms, that it might be used farther to the Northwest, and to prevent it so frequently winter-killing in the States where it is now commonly grown. Its power of adding atmospheric nitrogen to the soil should be increased by breeding from those plants which secure the most nitrogen, and possibly by breeding better forms of the bacteria which aid the clover in storing up atmospheric nitrogen.

ALFALFA should be made hardier, that its several crops annually of hay may be had in regions too cold for the common form. It is believed that material progress is already being made by several experiment stations in breeding hardy alfalfa.

These are only illustrations of the many problems which are becoming sharply defined as ready for clear, comprehensive experimentation, having in view definite results of vast economic importance to agriculture, and to all the people of America. Some of these problems are being worked out for limited localities; many should be undertaken for each locality. Where, how, and by whom can this breeding of plants and animals best be done, and how shall the necessary means be secured for this important and highly profitable, almost creative, work? Cooperation among private breeders and among Government and State institutions is well worthy of consideration.

HOW IMPORTANT RESULTS IN BREEDING ARE ACCOMPLISHED.

FEATURES OF SUGAR-BEET BREEDING.

In France and Germany sugar beets have been so improved by breeding that more than double the recoverable sugar is produced from an acre. The essential features of the plan are simple, direct, and effective, and may be briefly stated as follows: The varieties combining good yield of roots, high percentage of sugar, and low percentage of "solids not sugar" are selected for foundation stocks. A large field is planted to a given variety. The seeds are drilled in thickly and the young beets are thinned to a uniform distance, say, 7 inches, in rows 18 inches. When ripe, the plow is carefully run along the row to make pulling easy, and the beets are pulled and laid beside the row. Careful workmen now select all smooth, nicely formed beets of medium size (weighing 1¼ to 2 pounds) which have grown well down under

ground, and preserve them in pits in the field until the weather is so cold as to endanger them, when they are stored in deep pits, or in cool cellars (sometimes they are packed in sand), where they remain until near planting time. Before the rush of spring work, chemists, aided by laborers, analyze a sample of juice from each beet. With a small boring machine, a core of pulp is bored out of each root at a point near its center. The juice pressed from this pulp is strained, tested for its specific gravity, and clarified and tested by means of the polariscope for its percentage content of sugar. All roots which fall below a fixed standard of percentage of sugar content and purity of juice are discarded and fed to animals. The roots which prove best are assorted into classes, that is, those having, respectively, 15, 16, 17, and 18 per cent or above of sugar. Each lot is planted out by itself, and the seeds grown from the best roots are sold for a higher price than seeds from those which test lower. Where the breeding is done carefully, the roots in the lot having the highest percentage of sugar with high purity are so planted that each plant will have a given area of soil, say, 15 by 20 inches, that it may be compared with each other plant of its class. The yield of seed of each of these plants is recorded, and saved in a separate packet bearing the number of the mother plant. The third year the seeds of each of the many mother plants are planted in separate rows. When the beets are ripe for the sugar harvest, the yield, the average weight per plant, and the quality as to form, depth underground, etc., are recorded, and samples representing an average of each centgener[1] row from each mother beet are analyzed to get a measure of her centgener power in producing rich, pure juice. All stocks from mother plants making fair centgener records are used to produce seed, thus multiplying them into large quantities for sale for seed to farmers who grow beets for sugar factories. From among the beets of stocks making the highest records for their mother plants, large numbers of well-shaped roots of suitable size are chosen. These are analyzed, as were the beets first mentioned; the poor ones are

[1] *Centgener*, combining the root words of centum, hundred, and genera, generation, a hundred more or less (a large number) with a common parentage, is a word devised to aid in comparing the prepotency and breeding values of parents used in breeding by comparing the averages of a large number of the progeny of the respective parents. *Centgener power* means nearly the same as prepotency, as used in animal breeding, but is better adapted to use in hermaphroditic plants, with the male and female parents a single plant. The term *centgener tests* may be usefully applied to breeding animals as well as to mother plants. The owner of twenty trotting-bred mares having the choice of breeding them to a stallion with a record of 2:10 with many colts with records of 2:30, or to another stallion with a record of 2:30 but with many colts with records of 2:10, would at once choose the sire showing the best ability to get fast horses. The breeder of wheat, once he has under comparison the average yields for three years of plats of 100 of the progeny of the respective mother plants, pays little attention to the individual yields of mother plants. Centgener measures of mother plants or of breeding animals are much safer guides to their values as parents of improved strains than are measures of the individual qualities of parents.

FIG. 1.—NURSERY IN WHICH CENTGENER PLATS OF FLAX AND BEANS ARE ALTERNATED TO INSURE AGAINST TOO MUCH CROSS POLLINATING OF NURSERY STOCKS OF FLAX.

FIG. 2.—MACHINE FOR THRASHING CENTGENER PLATS.

FIG. 1.—STUDENTS RECORDING THE HEIGHTS OF WHEAT PLANTS CHOSEN FOR MOTHERS OF CENTGENERS.

FIG. 2.—PLANTING WHEAT IN THE PLANT-BREEDING NURSERY BY MEANS OF A NEWLY INVENTED MACHINE.

[This machine is somewhat larger than an iron jack plane and runs between two boards, the shoe making a furrow below. Nails, every 4 or 5 inches apart, in one of the boards work in notches in the seed disk and cause it to revolve and drop the seeds in hills.]

FIG. 1.—WORKING IN THE CENTGENER PLATS.

[When ripe all the plants in the centgener plats of wheat are pulled, placed in bundles, tied to the plat stake, and a strip of muslin 18 by 36 inches is wound about the heads to prevent loss by shelling or from sparrows.]

FIG. 2.—MACHINE FOR THRASHING CENTGENER PLATS OF WHEAT, WITH PLATS PLANTED TO INCREASE NEW VARIETIES TO QUANTITIES SUFFICIENT FOR FIELD TESTS.

discarded and the good ones are again graded into classes. The beets of the class highest in percentage content of sugar, high in purity, and rather large, again serve as mothers of centgeners, to be tested, and the best blood lines are again sought out to serve as the chosen basis for further improvement of the stock of beets. Since beets cross pollinate, hybridization and crossing are here potent factors, sometimes aiding and sometimes hindering the beet breeder. This rigid selection, long carried out, has resulted in the addition annually of one-eighth to one-half of 1 per cent to the sugar in the juice of sugar beets, and has decreased the impurities of the juice, thus making easier the manufacture of the sugar. This simple, effective plan, patiently carried out, has not only added many millions of dollars of wealth to the farmers, manufacturers, and transportation companies, but has given cheaper sugar to all civilized peoples.

FEATURES OF WHEAT BREEDING.

The plan of breeding wheat at the Minnesota experiment station (see Pl. XV, fig. 2, and Pls. XVI and XVII) follows the same general lines long used by the breeders of sugar beets. Hundreds of varieties of wheats were secured from Minnesota and from other States and countries. Less than a dozen of these, after several years of trial, were chosen as the best for foundation stocks. To start anew during a given year, ten superior varieties, new and old, are usually chosen as foundation stocks. Two thousand or even 5,000 plants are grown of each stock. By means of a specially devised planting machine, two or three seeds are placed in each hill. The hills are 4 by 4 inches apart for spring varieties, and 5 by 5 inches apart for winter wheats; and when the plants are a few inches high they are carefully thinned to one plant in a hill. The plats of wheat are kept carefully cultivated and free from weeds, so that each plant may have the same amount of room and the same opportunities as each of its fellows. When ripe, sheep shears are used in removing from the plat all but those plants which appear especially vigorous and heavy yielders of grain. About 5 per cent (100 out of 2,000 of each variety, or 1,000 out of the 20,000 of the ten varieties) are thus retained. The spikes of each of these are cut off and placed in a separate packet bearing the number of the mother plant. These are tested on small scales, and any of insufficient weight are discarded. The 50, more or less, remaining of each lot are now shelled and their net weight is recorded, as is also their quality, as determined by inspecting the seeds. The 10 yielding heaviest and showing superior grade of grain from each of the 10 foundation varieties, 100 in all, are now selected as mothers of nursery stocks. The second year 100 plants, called for convenience a centgener, from each of the 100 mother plants chosen as above, are similarly grown in the nursery plats. The entire centgener plat is now harvested by

pulling the plants. To correct for hills containing no plants, a record is made of the exact number harvested. From each of a dozen of the strongest appearing plants a spike is chosen to supply seeds for a similar centgener plat the third year. By means of specially designed thrashing and cleaning machinery (fig. 21) the seeds from the bundle are now separated. The weight of the thrashed seeds, plus the weight of those from the dozen chosen seed spikes, is divided by the number of plants actually harvested from the plat, thus giving the average yield per plant of each plat. These centgener trials are repeated for two more years, when the average yield per plant from each of the 100 mother plants may be compared. Those which yield highest and have had good average appearance or grade are now singled out and tested as to their percentage content of nitrogen, the quality of their gluten, and other qualities desired in milling wheats, or in macaroni wheats, as the case may be. Those nursery stocks (heretofore about one-third, or 30 out of the 100) which prove superior in the nursery and laboratory tests, are now increased during the fifth year so as to have sufficient seed for a field plat. Here the new varieties are given a practical field test, beside all the standard and the other best new wheats. Here, during the sixth, seventh, and eighth years since starting to secure the blood of superior mother stocks, each nursery stock[1] (now honored with a number for a variety name, as Minn. No. 163 wheat) is grown in the field beside its parent variety and other varieties competing for prominence. Any variety which here gains a very high record for yield and quality is sent to be tested by cooperating experiment stations, and is given rigid milling, baking, and chemical tests. If it runs the gauntlet as a superior wheat in the several States and in the mill and laboratory, its candidacy for wide distribution is accepted. Trained seed growers, preferably graduates of the school of agriculture, and other good farmers are chosen in each locality to become the experiment station's local seed disseminators, called seed

[1] The term *nursery stocks* is applied to the progeny of a few mother plants, or in some cases of only one, used as the mothers of newly bred stocks in the plant-breeding nursery. It has been found convenient to class them by the years in which they were started in the nursery and to use the Roman character I to designate originated by selection alone, and II, originated by hybridizing followed by selection Thus, 25 stocks of wheat originating by selection in 1901 are designated as I-1901, 1; I-'01, 2, etc., and 45 hybrid wheats originating from flowers cross pollinated in 1899 are designated as II-'99-1, 2, 3, etc. Nursery stock numbers are literally names of new varieties so long as they remain in the breeding nursery. Only the few which there prove best are taken to the larger field plats, where they receive variety numbers prefixed by the name of the State, as Minn. No. 13 corn, Minn. No. 169 wheat, etc., beginning a series with unity for each species, or for all species. Varieties reaching the highest place in the variety tests may be given proper names as an additional and special mark of distinction. These systems of numbers have proven of the greatest convenience in keeping records, historically following each identical stock of seed through nursery and field plats, and through trials by seed cooperators and farmers.

cooperators. The seeds are sold in quantities to plant small fields to these cooperators at 50 to 100 per cent above the market price of common grain, and these cooperators are expected, especially if they wish to be again thus chosen, to raise and sell to their neighbors for seed large quantities of the new variety. A sufficient number of reports are required from these cooperators, so that the experiment station may know how the new variety is holding up in yield with the wheats commonly grown in each portion of the State. All facts are freely advertised, so that the growers may know which variety is finally giving the largest returns per acre. Quantities of each new variety as distributed are also sold to seed dealers, that they also may increase it and widely distribute it. One variety, Minn. No. 163, has been thus widely and successfully distributed, and another, Minn. No. 169, is ready for dissemination for planting in 1902. It has been estimated that these two new varieties in only a few years will have repaid the

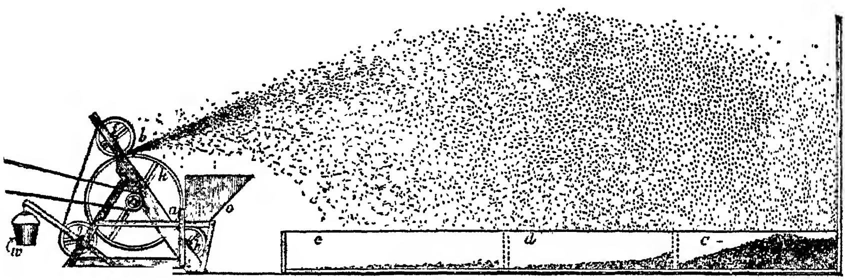

FIG. 21.—Machine devised by William Boss and J. M. Drew, of the college of agriculture of the University of Minnesota, for separating out the heavy, large kernels of wheat or other grain for planting: The three idle pulleys *f*, *g*, *h* carry the belt around, and pulley *h* is weighted so as to hold it tight against the large pulley *k*; the grain is fed in between the belt and the wheel at *a*, and is delivered at *b* with sufficient speed to carry the heaviest large kernels into the farthest bin at *c*; the smaller and lighter grains, suitable for market, fall into the central bin at *d*, while the light grains, the oats, etc., mostly fall in bin *e*.

State for all the money expended to date in plant breeding, including all the variety testing done by the station and substations.

FEATURES OF CORN BREEDING.

The breeding of corn, testing new varieties and distributing them, presents still different problems. Much has been done to increase the yields of this crop without laboratory methods. Dr. Hopkins, of Illinois, has shown that by the aid of the scientist's laboratory much can be done to better the quality of corn. He has shown that the percentage content of nitrogen and fat in corn may be increased in the same way as Europeans have increased the sugar in sugar beets. Corn is a very adaptable species. Its varieties become adapted to the locality in which they are grown, and each county, valley, or distinct district needs its own special variety of this crop. Breeders of corn are needed in each part of each State, who in their own laboratories, or by the aid of experiment station or other central laboratories, will improve both

the yield and the quality of varieties of corn especially adapted to their respective localities. Since varieties are cross pollinated by the wind for the distance of 40 rods, or possibly more, only one variety can be bred on a farm, unless it be a large farm, and a State experiment station can not undertake to breed as large a number of varieties of corn as it can of wheat. It can best accomplish results by securing cooperation from farmers who will breed corn with such aid as the station can render. In Illinois experiment-station workers employed by the State have wisely organized a limited number of corn breeders into a corn-breeders' association, which is developing an excellent method of giving each locality varieties which promise to make that State still more famous as a great corn State. With a large field of a superior variety in hand, the breeder of corn can select from stalks of the desired form and quality those ears which excel in yield and show a large percentage of the darker interior of the kernel, indicating richness in protein. Where it is practicable to have the grain of each ear analyzed for the percentage content of nitrogen and fat, this should be done, that only the blood of the best plants may be mingled in the seed-corn plat. A row of kernels taken from each side of the ear provides sufficient material for the analyst, and the expense of making nitrogen determinations is not very large. A row is planted from each mother plant. Two or three seeds in a hill, planted 15 by 42 inches and then thinned to one plant in a hill, makes a good stand in Minnesota. Farther south the hills should be 18 inches apart in the row. Each centgener is tested to determine the average yield per plant, that the relative value of the blood of the mother plants may be determined. Where practicable, a sample made up of 2 kernels from each of 50 average ears may be sent to the analyst to determine the nitrogen and fat content of each centgener. From these percentages the yield per plant of nitrogen and of fat may be determined, to be entered in the pedigree averages alongside the yield of dry matter per plant. From each centgener choice plants are harvested for seed the next year. From among these chosen plants the very best may be chosen for the corn-breeding nursery, while the seeds from the other good plants serve to plant a field of corn, to be carefully increased for commercial seed. In the seed-corn field only the choice ears should be chosen, and from among these the choicest should be planted for crops of seed, while that of next quality is sold to growers. While the breeder of apples need only produce the original tree and reproduce it from cuttings, and the breeder of wheat may make a variety from one mother plant, the breeder of corn deals with a species accustomed to freely cross pollinating. There is evidence showing that several mother plants should be here used in originating or improving a variety, as self-fertilizing or too close inbreeding of corn, being unnatural, causes deterioration.

SOME METHODS OF BREEDING USED BY FARMERS.

More simple, and possibly more direct, methods of breeding than those outlined may be used by farmers and seed growers. The definite work, however, supplemented by laboratory facilities, will bring results of far greater value to the people, and the State can well afford to be liberal in promoting the most painstaking improvement of crops. While selection requires by far the greater expense, patience, intelligence, and forethought, hybridization is a powerful agency in connection with selection. By cross pollinating two varieties, or nursery stocks, of wheat or of corn, the thoroughbred or stable character of each is broken up, but in the hybrid progeny we may find an occasional individual with blood lines superior to those existing in any mother plants to be found in either parent. Since, as a general rule, only one individual in several thousand has marked power to produce a valuable strain, the selection must be from among very large numbers, whether of hybrids or of plants merely selected from a definite variety.

Hybridizing does not always result in at once giving progeny better, on the average, than the parents. In very many cases the immediate progeny average much poorer than either parent. Hybridization is valuable because it multiplies variation, increasing that small number which, when used as parent plants or animals, have the power of plant No. 286, mother of Minn. 169 wheat, or of the original seed which produced the Wealthy apple, or of "Messenger," father of trotting horses, or of Stoke Pogis, sire of a most useful family of dairy cattle. The production of more remarkable mothers of centgeners is the purpose of hybridizing plants, while seeking out these rare germs, called by Professor Hansen the "Shakespeares of the species," is the purpose of selection. The labor of producing the hybrid germs is usually less than one part in a hundred, while the labor of eliminating all but the best selection is more than ninety-nine parts.

Lincolnshire sheep have been brought to their present perfection in the county of Lincoln, England, by many breeders cooperating in the careful production of large numbers of sheep in a relatively small area of country. Each year the best rams and many of the best ewes are brought to the Lincoln County Fair. Here each of the more expert breeders has under his view in adjacent pens the prize winners and many of their relations, selected by their owners from the large numbers left at home. He discusses the merits of each strain of blood with his fellows, until all know the relative merits of the sheep of each flock. During the year the distances are not sufficient to prevent his visiting the flocks where is being used the breeding blood of the value of which he desires to have a measure. If the rams from a given herd and line of breeding have produced flocks of sheep much improved over the ewes on which they were used, he learns the fact. Likewise, if any ewes have proven remarkable as dams and grand dams of superior sheep, he learns that, because it is in the interest of the owners to

point out these facts to him. Without any very formal way of recording the breeding powers, he is able to measure and compare the prepotency of the blood of the best parent sheep of the breed. And when he must secure a new ram, or wishes to secure a new strain throughout by securing both ewes and rams, he knows where to buy the best. England's strongest advantage in forming breeds, useful at home and throughout the world, is the fact that the farmers have gone to work by communities, usually by counties, to make and improve a breed. Much depended also on the fact that her farmsteads are on the farm, with lanes leading to the health-giving pastures, not in small village farmsteads without pastures, as in parts of Europe; also on the love that the English farmer has for his domestic animals, and to some degree on the suitable conditions of climate and of food materials. In spite of rather crude methods of securing the centgener, or breeding values, of bulls and cows, the farmers of Jersey and Guernsey islands have improved their cattle along dairy lines, mainly because grouped near together were large numbers of animals. The American trotter is being rapidly improved, because distance does not hinder the transmission of individual records, of centgener records (here the number of progeny which each sire or dam has in the fast trotting list), nor even the shipment of the dam to the desired sire, while the exceptionally good sires are often transported to do service in the stud, or are used when on tours campaigning on the race courses, thus resulting in the selection of the few best from among the very many. On the other hand, our beautiful stock of Morgan horses was well-nigh lost because these animals have been widely scattered, and because no one kept, tabulated, and emphasized the breeding powers of sires which displayed the strongest power in producing those colts which were at once hardy, long enduring on the extended drive, adapted to the plow, docile, prolific, long-lived, and handsome.

COOPERATION IN BREED AND VARIETY IMPROVEMENT.

Our promising stock of Redpolled cattle is widely distributed, one herd here, another there, possibly hundreds of miles between. The herds of milking Shorthorns are scattered around the earth, but centered nowhere. How can the breeders of these cattle gain inspiration or knowledge from each other? How can they measure the breeding power of the different parents of blood lines? The fairs are almost misleading to the breeder of cattle combining milk and beef. The milk-giving power can not be measured by the show-ring judge, and he must judge on the quality which he sees; hence, he is tempted to select those with good beef outline, hoping that he may not do injustice to those with superior milking qualities. Here breeding valuations to be useful (not to do serious harm) must comprehend more than one quality. They must include the ability to transmit both good beefing and good milking qualities, together with the vitality to resist

tuberculosis, the tendency to live long, and be prolific in bearing a large number of young. An owner of a herd of milking Shorthorns, or of Redpolled cattle, who is isolated, will do well if he retain the excellence of his herd unless he has unusual facilities to travel and study the herds from among which he must choose his bulls. Most of such herds have been sooner or later seriously injured as general-purpose cattle by the selection of a bull weak in dairy qualities. The herds of these classes of cattle, if they were all collected into a few counties, would go forward rapidly to the success which they might merit. And what a blessing it would be to this country fifty years hence if this were now done! Large numbers under similar conditions where records of prepotency may be kept, compared, and used is as necessary in animal as in plant breeding. In animals the valuable parent germs secured through hybridizing, crossing, and selecting must be led to uniformity, and this usually means the elimination of most of the blood excepting that of a few animals which comes down with such a peculiar power that other blood lines are crowded into the background and kept there.

Plans long since formulated by the writer, assisted by Mr. Andrew Boss, for the production of a strain of hogs with a very large amount of tender, lean meat, abundant fecundity, strong bones, early maturity, large growth from a given amount of food, and with sufficient uniformity of color and form to distinguish the breed, are being worked out. A method for recording the percentage content of lean meat in the dressed carcass and in the live animal is being devised. The centgener record of the dam and sire can be determined by using half of each brood which are killed for that purpose at or near maturity. The method of measuring the percentage content of lean meat, with instruments especially devised for that purpose, can be applied to the carcasses as ordinarily cut up for market. The number of pigs farrowed at each litter will be recorded; the strength of bones is to be judged or measured and a percentage record made; the earliness of maturity will be considered, and by means of feeding experiments for several weeks at a given age the amount of standard food required to produce a pound of gain, or a pound of lean meat, is to be recorded for the progeny of each sire and dam. These intrinsic qualities and the facts as to color and form are to be entered in the records along with the centgener percentages. There are two difficulties to be overcome. One is the use and elimination of the very large numbers required to find the few foundation parents with the strongest power to produce the desired breed of hogs. A number of breeders cooperating can best take advantage of large numbers of animals. The other difficulty is the long time which must elapse before hogs are produced from which are eliminated nearly all but the desired qualities, and which are sufficiently uniform to sell as pedigreed hogs for pedigreed breeding and upgrading purposes. As in breeding plants, more than half the

battle will be won in securing from among the known breeds and grades of cross-bred hogs the foundation stocks from among which may be found the parents with the strong centgener power most nearly combining all the strong qualities blended in our ideal. Ten years to develop new wheats by selection has not been too long; nor fifteen years to develop new wheats by hybridizing followed by selection. Similar periods of time, together with much effort and money, would be none too long a time nor too much expense, if greatly improved hogs would result for the increase of wealth of the State and the profit of the breeders. Private parties, firms, herdbook societies, or institutions, singly or in cooperation, which will thus, through ten years of experimentation with large numbers, find the blood of the very few best and make complete records of the values, as well as multiply their stocks for sale, will have improved strains, or new breeds, as the case may be, which will be in demand at very high prices and which will greatly bless producers generally.

BREEDING OF CROPS AND ANIMALS WORTHY OF HIGHEST SCIENCE.

Breeders of sugar beets, corn, pouter pigeons, pointer dogs, fiber flax, large plums, long-fibered cotton, trotting horses, dairy cows, eight-leaved clover, and of other wonderful productions have proved that by breeding, profound changes may be produced in any characteristic or in any combination of characteristics. If we can change the percentage of sugar in sugar beets, we can breed the lean meat thicker on the backs and hams of hogs or steers. If the percentage of protein and fat can both be increased in a variety of corn, we can breed a class of cattle which will excel in a combination of lean meat and butter production.

Instead of the most intelligence being displayed in breeding ornamental plants and fancy or pet animals, the highest science and art should be extensively employed in breeding those staple crops and domestic animals which represent so much of our wealth production. States could well afford to inaugurate a system of live-stock pedigree records based on performance, measurements, fecundity, etc. County cooperative associations might record the individual characters, somewhat as is done in the island of Jersey with cattle, and the state might properly pay for supervising, recording, and tabulating the centgener records of qualities and performances. Under the present system we are losing all knowledge of valuable blood of too many animals with the peculiar power and value of a "Messenger," and we are emphasizing the blood of too many animals which can win on their form in the show ring, but would fail in a contest on the block, at the milk pail, or in the work team. We base too many breeding records on show and too few on intrinsic merit.

Shall we continue to grow crops and breeds of animals bred for a climate and conditions unlike ours, thereby losing hundreds of millions annually, or shall we breed in America for American conditions?

AGRICULTURAL SEEDS—WHERE GROWN AND HOW HANDLED.

By A. J. Pieters,
Botanist, in Charge of Seed Laboratory, Bureau of Plant Industry.

Introduction.

It is a little more than a hundred years since the United States has imported any considerable quantity of red-clover seed. For many years before that, grain, clover, and grass seeds had been gathered and sold in the Colonies, but much had always been imported. This condition was reversed soon after the opening of the nineteenth century, and from that time the amount of seed raised in America for home consumption and for export has steadily increased, until to-day Europe looks to the American farmer for a large part of her supply of agricultural seeds. On our side, we import in quantity only a few kinds, the culture of which is still comparatively new in this country. Of necessity, the improvement of machinery for harvesting, thrashing, and cleaning seed has kept pace with the increased output. This could not have been otherwise, since without better machinery the seed of some grasses, and even of clover, could not have been economically produced in quantities sufficient to supply a large demand. The domestic production of seed has tended to reduce prices, and to-day the seeds that are so expensive as to seriously limit their use are all imported. In some cases, not counting cereals and flax, the seeds of agricultural plants have assumed such importance in trade that they are quoted on the produce exchanges or on the boards of trade of all the large cities, and dealing in futures in clover and timothy seed is as regular a part of the trading as in the case of corn or wheat.

Extent and Importance of the Trade in Agricultural Seeds.

That the trade in agricultural seeds has assumed enormous proportions needs only to be mentioned. Unfortunately, data are not available for making reliable calculations of the quantities and value of all seeds produced or sold in the United States. Some statistics are, however, at hand showing the amounts of clover and timothy seed produced by a few States. The export trade in clover and grass seed during the year ending June, 1900, amounted to $3,050,193, and of course the domestic trade is vastly greater. In 1900 the clover-seed crop of Illinois aggregated 52,992 bushels, and Missouri sent out of the State 51,683 bushels. In 1899 Ohio reported 350,777 bushels of

clover seed produced in that State; in the same year Michigan produced 68,744 bushels, Wisconsin 85,423 bushels, and Missouri more than 30,000 bushels. In 1897, a year of large clover crops, 810,341 bushels were grown in Indiana alone.

In 1900 Illinois produced 103,401 bushels of timothy seed, valued at $188,831, and 60,649 bushels of Hungarian and millet seed, worth $37,770. The crop of timothy seed raised in the State in 1900 was the smallest for more than twenty years, the high-water mark for value, although not for production, having been reached in 1881, when the timothy-seed crop was worth more than $1,000,000. The amount of timothy seed harvested in Wisconsin in 1899 was 61,786 bushels; while Missouri, in the same year, produced 72,535 bushels, besides more than 1,000,000 pounds of unclassified grass seed. In 1900 Missouri reported the amount of timothy seed exported as 2,976,648 pounds, and of millet seed as 2,851,300 pounds; in the same year Iowa produced 114,700,950 pounds of timothy seed.

These figures serve to convey some notion of the volume of the trade in agricultural seeds in the United States.

Centers of Production.

While most of the important seeds can be produced throughout the greater part of the United States, yet there are centers where these seeds are produced most abundantly and most cheaply, and from these the commercial supply is therefore largely drawn. Not only does the trade look for sections in which such seeds can be most cheaply produced, but also where those of the best quality are to be had. Certain sections have the reputation in the seed trade (whether well deserved or not is in many cases still an open question) of producing the best quality of a certain kind of seed. For example, the more critical trade always demands Tennessee or Southern-grown German millet seed, although the Western seed is cheaper. Seedsmen believe that the Southern seed gives better crops than seed produced in Nebraska or the Northwest. So also Northern-grown red-clover seed is more valued than any other, and commands the highest price in the market. These areas of production are in some cases rather limited, and in others are coextensive with the boundaries of many States. Sometimes the areas of production are localized and separated by thousands of miles, chance or similarity in conditions having given birth to the same industry in widely distant places.

Classes of Agricultural Seeds.

For the purposes of a general survey of the areas and methods of production, agricultural seeds may be divided into the following classes:

Cereals, including such seeds as wheat, corn, buckwheat, oats, rice, and the like.

Clover and other leguminous forage plants.

Common grasses and grass-like forage plants, including among the latter the various sorghums, teosinte, etc.

Fancy grasses.

Miscellaneous agricultural seeds.

This classification is, of course, rather arbitrary, and is used solely as a matter of convenience in treating the subject.

CEREALS.

The trade in cereals for seed purposes must be carefully distinguished from that trade in wheat, corn, etc., which is a daily feature of the Chicago and New York markets. Seed wheat is not bought on 'change, nor is the price of high-grade seed corn affected by the fluctuations of the market. The great bulk of the seed of the cereals is undoubtedly grown in the locality where it is to be used; most of it does not move far. The seed that is offered for sale by dealers is obtained in three ways: Some dealers buy seed in the open market, selling by the name under which the seed was bought, without inquiry of any sort into the quality or the origin of the seed. Such dealers usually sell seed that should have found its way to the nearest grist-mill. Other dealers, while buying by sample in the open market, use all the care the circumstances permit to obtain correctly named seed of good quality. This seed is, if necessary, recleaned, the light and injured seeds removed, and only good, sound seed exposed for sale. A third and small class of dealers make a specialty of some varieties, and these are grown for the dealer under contracts in the same way that vegetable seeds are grown. Such seed is of the highest quality and, what is of great importance, is almost always true to name. In general, good seed of any of the different classes of wheat comes from the section in which that class is most commonly grown. For example, seed of Turkey red wheat should be bought in Kansas, Nebraska, or Iowa; Sonora wheat in California; hard spring wheats in the Dakotas, Minnesota, or States in that section.[1]

It is a commonly accepted rule that plants raised from Northern-grown seed will mature earlier than those from Southern-grown seed of the same variety. This rule holds good for spring-sown wheats, of which the Northern-grown seed is preferred, but the contrary is true of fall-sown grain, the latter ripening earlier from Southern-grown than from Northern-grown seed.[1]

CORN.

More seedsmen make a specialty of corn than of wheat, rye, or oats, and reliable dealers are reasonably careful to have their seed grown

[1] Carleton, M. A., Cerealist, U. S. Department of Agriculture.

for them true to name and free from any mixtures. This is much more difficult to accomplish in the case of corn than of wheat, since the former cross pollinates readily, the light pollen being shaken from the tassels and carried by the wind sometimes for considerable distances. Wheat being self-fertile, may be grown anywhere without danger of crossing, while each variety of corn must be widely separated from any other if it is to be kept pure.

The breeding of corn for seed purposes is rapidly taking such an important place in corn culture that many of the best farmers buy seed only from the members of the corn breeders' associations in the different States. These associations have been formed for the purpose of improving the quality of corn by selection and for the protection of the buyer as well as the seller of seed corn.

BUCKWHEAT.

Buckwheat is grown from New York to Kansas, most of the seed used being of local production. Some dealers, however, have their Japan buckwheat seed grown under contract in order to keep up the quality of the variety. Seedsmen usually buy seed by sample and reclean, losing 5 per cent or less in the process.

Oats for seed are raised wherever the oat crop is grown, but some varieties are perhaps more grown for seed in some States than in others, Texas and Georgia, for example, being possibly the largest producers of the rust-proof oats. The varieties of winter oats are all grown south of the Ohio, while the best seed of spring oats is Northern-grown. Unless seed is grown on contract, it is bought by the dealer on sample and not by grade.

RICE.

Rice is, of course, produced in the Southern States. The seed rice is grown in the same way as that which is to be used for food and harvested at the same time. The time of harvest for South Carolina is August 20 to September 20 for early rice and October for late rice. That intended for seed is not thrashed with the other, however, but is removed by whipping the straw over logs or beating with a flail. The straw is then passed through a thrasher to save what grain is left on the straw. The seed rice is run through a fan to take out the dirt and short straw. In Louisiana the crop is harvested in August and is thrashed with a common wheat separator, the charge being 10 cents for a sack of almost 4 bushels. Seed rice that is free from weed seeds, and especially from the red rice, commands a good price.

CLOVERS AND OTHER LEGUMINOUS FORAGE PLANTS.

Five true clovers are more or less common on our farms, and of these we regularly import seed of two, the crimson and the alsike. It

FIG. 1.—SAMPLING CLOVER SEED. TOLEDO, OHIO.

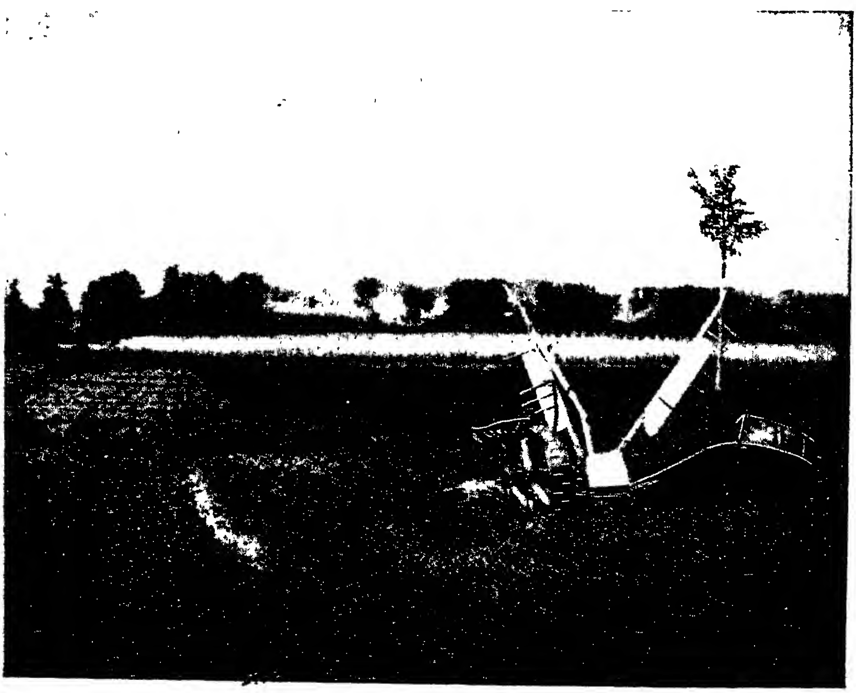

FIG. 2.—CUTTING RED CLOVER SEED WITH A SELF-RAKE, NEAR HOLLAND, MICH.

is true that a little red and a little white are occasionally bought abroad, but this is usually not due to a scarcity at home, but because the condition of the market enables the American dealer to trade in this way with a profit. Even so, the importation of red clover is rare and confined to very low grades, which are used to reduce the price and quality of higher grades at home. However, some mixed seed, consisting of red clover and timothy, together with other seeds, is regularly imported from Canada by New York dealers, who separate the seeds and market the cleaned clover and timothy. Alsike is regularly imported to a greater or less extent from Canada, and some from Europe. Thousands of pounds of crimson clover come every year from France and Germany.

GRADING AND SAMPLING CLOVER SEED.

All seed can not, of course, go into one grade. Much of the seed coming to the Toledo (Ohio) market, for example, can not be made equal to Toledo prime, no matter how well it may be cleaned, because the seed has not the size and color requisite for the grade. Such seed is graded as "Number 2" or as "Rejected," according to cleanness and appearance, and is sold on the Toledo Board of Trade under these designations. Poorer qualities are bought and sold only by sample. Some large cities have regularly authorized grades and an inspector, whose certificate is accepted in trading transactions. In other cities there is no fixed grade, dealers buying by sample or using the grades of the chief centers of the clover-seed trade as a basis.

A clover-seed inspector is regularly employed by the Toledo Board of Trade, and it is his duty to sample every bag of clover seed offered in that market, fix its grade, and furnish a certified sample to the owner of the seed. These samples are drawn by means of a "trier," or clover-seed sampler, which is thrust through the bag, allowing the seed to run out at the open end of the trier. The sample drawn from each bag is allowed to run into a compartment of a tray. When the tray is full the inspector examines the whole carefully, and then mixes all together to make up the sample for that lot of bags. (Pl. XVIII, fig. 1.)

HOW CLOVER SEED IS BOUGHT AND SOLD.

In all the great centers there are certain definite rules governing the trading in clover and grass seeds. These rules are usually prescribed by the board of trade or by the produce exchange of each city. The greatest part of the trading is, however, done by sample. When a firm has a quantity of seed to offer, it sends samples to other dealers, quoting price on this sample, which is known by some word, letter, or number for identification. If a purchase is made on these terms the seed delivered must be equal to the sample. The wholesaler will commonly buy any clover seed offered, and much that comes

directly from the farm is in very bad condition. Not long since the writer was present during trading hours on the floor of the board of trade in one of the largest cities of the country, and saw a sample of clover seed offered that appeared to be largely bracted plantain. It was bought by a dealer, who called attention to the fact that the clover seed in the sample was large, and that his machine could readily separate the clover from the plantain and get a high grade of clover out of the foul seed. Since the whole had been purchased at a low figure, there was a good profit in the transaction. From the wholesaler the seed goes to the retailer, chiefly the country storekeeper, who sells to the farmer, and thus the clover seed completes the cycle from the farmer who produces to the farmer who consumes, through the medium of the dealer acting as distributing agent.

RED CLOVER SEED.

Red clover seed is produced in every State from the Hudson to the one hundredth meridian and from Canada to the northern border of the Gulf States. In the earlier years of the last century New England was also an extensive producer, but the area of the profitable production of clover seed gradually moved westward, until the New England farmers found that they could more cheaply buy New York, Pennsylvania, or Ohio seed than raise their own, and to-day there is practically no clover seed grown east of the Hudson. Later the same process was to a certain extent repeated for New York, Pennsylvania, Maryland, and Virginia. The clover fields became foul, bad seasons left poor crops, and the Western seed was cleaner, larger, and cheaper, so the farmers left off raising seed and bought from Ohio, Michigan, and Illinois. To-day many farmers in the Atlantic coast States outside of New England produce their own clover seed, but practically none of it is on the market, certainly not outside of the neighborhood where it was grown.

The source of supply for the enormous volume of trade in red clover seed to-day is found in the States of the Ohio Valley, besides Michigan, Wisconsin, Iowa, and Missouri. Other States produce some, but usually not enough for the home demand. Of these, Minnesota, eastern Kansas, and eastern Nebraska are producing more each year, and the center of clover-seed production is steadily moving westward.

Red clover seed is an incidental crop, which is taken when conditions are favorable, but upon which the farmer does not depend with as much regularity as he does upon corn or hay. It is therefore extremely difficult to collect reliable data for a prediction of the crop; nevertheless all the principal dealers take great pains to ascertain in advance what the prospects are each year. Though probably influenced at times by a speculative market, the price of clover seed is usually controlled by supply and demand.

The seed is saved from the fall cutting of the second year's clover crop. The early cut is made into hay, and if the weather is favorable a second crop of blossoms develops and ripens seed during the latter part of August or the early part of September. If, however, an unusually dry spell has injured the hay crop, the second crop is frequently also cut for hay. Up to the time of cutting, therefore, the acreage of clover seed is a very uncertain quantity, and the amount of seed that may be expected per acre is still more uncertain. The yield varies from 1 peck to 4 or 5 bushels per acre, according to circumstances, averaging about 2 bushels per acre as a normal yield.

The crop is cut by mowers or by self-binders with the binding apparatus taken off, or by the old self-rake, which is the best machine for the purpose. (Pl. XVIII, fig. 2.) When a mower is used some device is generally employed to keep the clover from being trampled by the horses. When well dried the seed is hulled out by special hullers, which also partially clean it. The seed is then either sold directly from the huller or is recleaned in a fanning mill and sold to local dealers in the small towns throughout the clover belt. These men buy the seed in lots of a few bushels, and when they have accumulated a carload or two it is sent to the large centers and consigned either to wholesale dealers direct or to commission men, who resell to the wholesale dealers. The latter, of course, buy seed of all kinds and qualities, paying for it according to the market price of the grade at the time the seed is bought. They then reclean and bulk the seed, that is, mix up the cleaned seed thoroughly so as to make a uniform grade.

MAMMOTH, ALSIKE, AND WHITE CLOVER.

Mammoth clover seed is grown in the same States as common red. The seed must be taken from the first crop, since, if cut for hay, the second crop can not be depended upon to mature seed. The method of handling is similar to that described for common red clover. It is a more certain seed crop, and is often recommended as a money crop for the seed and as a soil enricher.

Alsike clover is grown in the Northwestern States, Wisconsin and Michigan producing most of the seed, while some is also grown in Minnesota and Ohio. Canada is a large producer of prime alsike, much of which comes to the United States.

A few men, chiefly in Wisconsin, make a specialty of growing alsike and white clover seed, which latter is almost all grown in that State, and in rather limited areas. These two species present no peculiar problems, except it be in the fact that from its low growth the white clover needs more care in harvesting than either red or alsike. The white clover grows wild throughout the Northern States, though but little effort has been made to save the seed, except in a limited area in one State.

CRIMSON CLOVER.

Crimson clover seed is produced in Delaware and Maryland, small amounts being raised also in Ohio and Virginia. The seed is ripe in the latter part of May or early in June, and is more difficult to handle than any of the other clovers. The fruit containing the seed readily falls from the head when ripe, and much is lost in this way, unless the seed is harvested just at the proper time. A rain on the cut clover or a spell of wet weather when the seed is nearly ripe may do great damage by causing the seed to sprout in the head. The home supply of crimson clover seed is not equal to the demand and much is annually imported.

BUR CLOVER AND SWEET CLOVER.

Bur clover (*Medicago maculata* and *M. denticulata*), also called California clover and hog clover, which has proved a valuable plant in certain parts, produces seed wherever it grows, but there are at present two chief areas for the commercial supply of the seed. These are in California and Georgia. In both areas the method of harvesting and handling is substantially the same. The burs ripen from June to July and readily fall from the plants, which are by that time quite dry. The dry plants are then removed with pitchforks and the burs swept up with brooms.

The yield is from 50 to 100 bushels per acre, 10 pounds being the weight of a bushel of burs. The burs should be gathered as soon as possible after they fall, to prevent their becoming black. If a rainy spell overtakes the burs on the ground the seeds germinate, which ruins the crop. When the burs are gathered they are freed from dirt and broken plant matter as much as possible, but the seeds are not hulled out of the burs. There are usually three or four seeds in each bur.

Sweet clover seed, also known as Bokhara clover seed, is nearly all grown in the State of Utah and in the county of that name. Some is also harvested in Alabama, Ohio, and New York. It is harvested with a self-rake machine and is hulled in a common grain thrasher, the screens merely being changed. The fruit falls from the stalks very readily, hence great care is needed in harvesting. The harvest takes place about September 10 to October 10, and the yield is about 250 to 400 pounds per acre. The seed is sold by sample, and is usually recleaned by the dealers, who lose 5 to 10 per cent in the process.

ALFALFA.

Alfalfa seed is grown mostly in the far West, Utah and Kansas producing the largest amounts. Some is also grown in Colorado, California, and Nebraska, while in Ohio small amounts have been marketed for several years. The methods of growing and handling, alike for the most part in all places, differ somewhat in details in the various States in which seed is grown.

In Utah the seed is saved from either the first or second crop, the seed from the former being considered the best if the growth is not too rank. The first crop when taken for seed is harvested in August, the second crop in September. In Kansas the second or third crop is used for seed, and is harvested in August or September. The weather is so much more favorable for harvesting during August and September that the seed crop can be handled more safely at that time than earlier. It takes twice as long to cure a crop of seed as a crop of hay, hence steady weather is of the utmost importance.

The amount of seed secured per acre varies from 1½ bushels to 10 or 15 bushels, according to soil and season. In many places the seed is still thrashed with a grain separator, while in some places clover hullers are used. The seed is usually sold by sample, though sometimes by grade. The dealers commonly reclean the seed they buy from the growers, losing 5 to 50 per cent in cleaning. As in all field seed purchases, allowance is made for this loss, either by both parties agreeing on an estimate of so many pounds of loss to the bushel or by actually cleaning the seed and weighing the screenings. Some alfalfa seed is imported from France under the name of lucerne, but this has been almost crowded out of the market by the Western seed, and to-day it is not easy even in the Eastern cities to get good imported seed in large quantities.

COWPEAS AND SOY BEANS.

Perhaps the most important of the leguminous forage plants besides those mentioned above is the cowpea. The area in which this great nitrogen gatherer is used as a soil enricher increases every year, and the demand for seed is such that the price remains at about $2 per bushel. The cowpea is a plant of warm weather and long season, so that with some exceptions the varieties do not produce seed, or at least can not be depended upon to produce seed, north of the Ohio River. The crop is grown and seed produced in almost every Southern State and upon almost every farm. In many cases it is planted as a catch crop in corn, and then the yield is 5 to 10 bushels per acre. If properly cultivated, it will yield 10 to 30 bushels.

Cowpeas are allowed to become well ripened before harvesting, which is commonly done with a mower. The vines are piled in small cocks and frequently turned until dry. Thrashing is best done with a bean thrasher, but a wheat separator may be used with the concave lowered and many teeth removed. In some places also the flail is resorted to or the peas are trampled out by horses on the barn floor. The seed is sold by sample, as there is yet no standard grade or price.

The soy bean, which shares with the cowpea the reputation of an excellent forage and fertilizing crop, has a more northern and western range than the latter. The early varieties mature seed in Ohio and

in Kansas, and some varieties seed very heavily. The pods grow close to the ground, and the ordinary harvesting machine can not be successfully used. For small areas a "knife cutter" is recommended, consisting of a sharpened piece of strap steel bolted to a two-horse cultivator. This knife runs just below the surface of the soil and cuts the stems, which are not so hard below as they are above ground. For larger areas special harvesting machines are used. "Thrashing is done with an ordinary separator, using all blank concaves, and running as slowly as the machine will permit and not clog the shaker." Care is needed in keeping the seed. It should be stored in loose woven bags, only partially filled and kept dry. If put in close bags or in deep bins in quantity the seed may heat enough to injure its vitality.

The yield in Kansas varies from 15½ to 30 bushels per acre, according to the land, and the expense of growing, harvesting, and thrashing the crop is about 55 cents per bushel.[1]

CANADA FIELD PEAS AND HAIRY VETCH.

In the extreme Northern States and in Canada the place occupied by the cowpea in the South is taken by the Canada field pea. This is a genuine pea, which the cowpea is not. It is known to the trade in a number of varieties, the seed being mostly produced in Canada, Michigan, and Wisconsin. Some seed is produced in Oregon.

The seed of the hairy vetch, which has proved to be a valuable cover crop and early forage plant, is at present practically all imported, and commands such a high price that extensive planting is out of the question, but yet the supply is not equal to the demand. It comes chiefly from Germany, where the hairy vetch is much grown. When planted for seed purposes from one-half to two-thirds as much rye is planted with the vetch to furnish support for the latter. The rye and vetch ripen and are harvested at about the same time, and since it is difficult to separate the seeds perfectly, hairy-vetch seed usually contains some rye.

It is the common opinion among dealers that the vitality of this seed, which is often poor, is seriously affected by the sea voyage, and it is thought that storing in bags is also injurious, open bins being recommended. A little of this seed has been grown in the United States, but the question of profitable production appears to be chiefly one of labor. The pods ripen irregularly, and hand picking is necessary to secure a full crop.

VELVET BEAN AND BEGGAR WEED.

The velvet bean, a rather new forage and fertilizing plant, produces seed only in the extreme south of the United States, Florida, especially

[1] Information regarding harvesting, thrashing, and handling of soy-bean seed is from Report of the Kansas State Board of Agriculture for quarter ending March, 1900.

the southern portion of the State, producing most of the seed, some being also grown in Louisiana. The beans need a long season to mature, and ripen late in the fall. The pods grow in clusters of 12 to 18 pods, and harvesting is usually done by hand picking. The pods are thrown into barrels, which hold about 100 pounds, and will shell out approximately 1 bushel of clean beans, the accepted weight of a bushel of beans being 60 pounds. The barrel of pods has become a standard in the sale of these beans, and pods are bought by the barrel or by the bushel of 100 pounds; in either case it is expected that there will be 60 pounds of clean beans.

The beans are usually marketed in the pod, few farmers having the machinery necessary to thrash and clean them. The buyers thrash out the beans with special machinery designed to prevent breakage. Attempts have been made to thrash from the vine with separators in order to save the labor of hand picking, but the chief trouble has always been with the breaking of the seeds. Some growers prefer to harvest by gathering up the vines. When these are green they are pulled loose by running a triangular harrow over the field, after which the vines are raked into piles to dry. If the crop is not wanted until the vines are dead they may be raked up with a horserake. It is claimed that while in hand picking about 30 per cent of the pods are left on the vines there is practically no waste when vines and all are gathered. The vines are run through a separator built much like a wheat separator. This cracks more seed than the huller, but those who prefer this method say that the broken seeds are just as good for feed, and hence there is really no waste.

Another Florida product is beggar-weed (*Meibomia tortuosa*) seed, of which only a small amount is saved, most farmers permitting the plants to reseed themselves. This they do abundantly, so that by the time the corn is ready to harvest the beggar weed is often higher than the corn. The seed is hand stripped, and is mostly sown in the rough. When cleaned it has the color of old alfalfa seed, is glossy, and is shaped somewhat like a small bean.

COMMON GRASSES AND GRASS-LIKE FORAGE PLANTS.

Of all grasses used for hay and pasture, timothy is doubtless grown more widely than any other. Four other grasses—meadow fescue, orchard, Kentucky blue, and redtop—produce seed abundantly in the United States, and the seed crop is of considerable value. Besides these, the seed of beardless brome grass (*Bromus inermis*) is now produced in the Northern United States and in British Columbia, but not yet in sufficient quantities to supply the demand. Many thousands of pounds are still imported every year, although, as a rule, the quality of the imported seed is not equal to that of the domestic.

TIMOTHY.

Enormous quantities of timothy seed are sold every year, many thousands of pounds being exported. The chief market for this seed is Chicago, where hundreds of carloads of seed are handled every season, and whence it is distributed to other points, more especially in the Eastern States.

The seed is grown in many States, from Ohio to Idaho, but for the trade chiefly in Illinois, Missouri, and Iowa, the southeast corner of Iowa being perhaps the most important timothy-growing section in the world. In Utah and Idaho fine large seed is also produced.

Timothy seed is harvested about July 15 to 20, and is thrashed with a common separator. The cleaning is mostly done by dealers, from 1 to 10 per cent being cleaned out. The seed is sold either by sample or by grade, the Chicago grades being known and used by many merchants within the area supplied by the Chicago trade. Timothy seed is usually sown in the fall, and consequently the trade in this seed is brisk from shortly after harvest time until November.

MEADOW FESCUE.

The seed of meadow fescue (*Festuca elatior pratensis*), also called English blue grass, is nearly all Kansas-grown. The industry began in that State in Johnson County, which still leads in the production of the seed. Other counties in Kansas and portions of northern Missouri, Kentucky, and Ohio also produce some seed. Kansas is said to produce 75 per cent of the crop in the United States,[1] the largest crop, amounting to 140,000 bushels, having been harvested in 1896.

Meadow fescue yields the best seed crops for from three to five years after planting, after which there is a decline, and the fields are plowed and planted to other crops. Good crops are from 6 to 12 bushels (of 24 pounds) per acre, though 15 to 18 bushels are often secured, and sometimes, but rarely, the yield is as high as 20 bushels. The crop is harvested directly after wheat, with the same machinery and handled in the same way, thrashing being done with a wheat separator at a charge the same as for grain, or sometimes double that amount is asked.

"The seed is sought at harvest time, or soon thereafter, by wholesale seed houses in the West, either by letter or through representatives who personally visit the farmers to make purchasing contracts. The competition of the seed firms ordinarily induces the paying of prices to growers in line with conditions of supply and demand, but demand is the prerequisite factor. The annual foreign requirement is an uncertain quantity, and hence varies. Home needs are not material in influencing prices. Formerly Western seedsmen resold to Atlantic-

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[1] Gilmore, J. S., Report of the Kansas State Board of Agriculture for the quarter ending March, 1900.

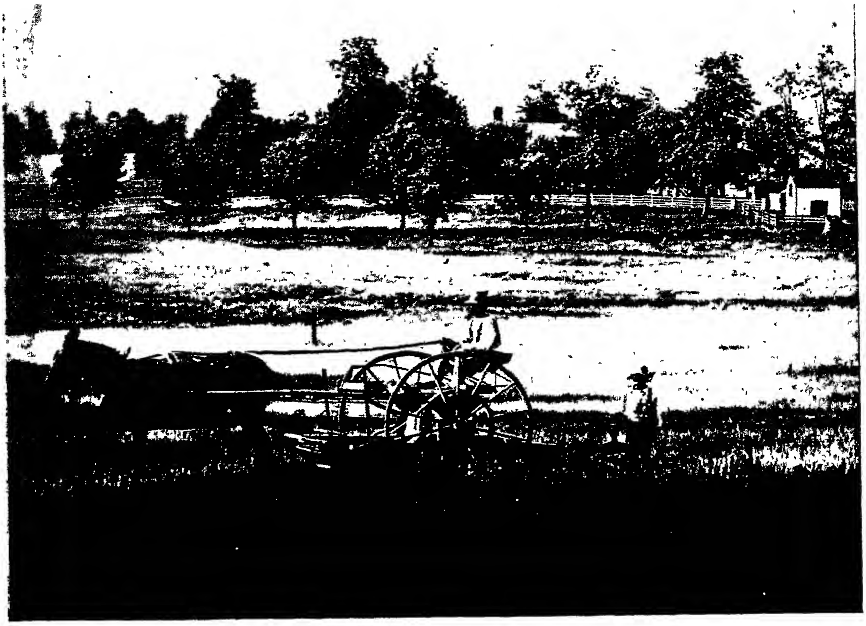

FIG. 1.—HARVESTING KENTUCKY BLUE-GRASS SEED.
[Photograph by Prof. H. Garman, Agricultural College, Lexington, Ky.]

FIG. 2.—A FIELD OF PUMPKINS GROWN FOR SEED.
[Photograph loaned by D. Cummins.]

board exporters, but they now sell direct to foreign importers. The seed goes to Germany, Denmark, the Netherlands, France, Holland, Great Britain, Australia, and some to Ireland, in all of which it is sown for pastures and meadows, mixed with other grasses. Germany is the largest taker."[1]

ORCHARD GRASS.

Orchard-grass seed is a Kentucky product, although some is grown in southern Indiana and in Nebraska, and small lots in southern Virginia and in Maryland. This seed is also largely grown in New Zealand, and comes in competition with the American seed in the European markets. It is sometimes even placed on the American market, but as yet infrequently and in small lots. In Kentucky orchard-grass seed is harvested in the latter part of June. Some allow sheep to pasture in the fields after the flower stalk has been sent up, because they will eat the weeds and clover, making the work of harvesting and thrashing easier. The grass is cut with a self-binder, tied in bundles, and left to dry in uncapped shocks. The seed is thrashed with wheat separators having specially constructed sieves. As it comes from the thrasher the seed needs recleaning to make high-grade seed, but much is sold just as it comes from the thrasher; it is commonly sold by sample. The crop is from 8 to 20 bushels per acre.

KENTUCKY BLUE GRASS.[2]

The seed of the Kentucky blue grass (*Poa pratensis*) is, like that of orchard grass, mostly harvested in Kentucky, the blue-grass region being about Lexington, Paris, and Winchester, and thus east of the counties in which orchard-grass seed is produced. Some blue-grass seed is also saved in Iowa and in northwest Missouri, and the amount is steadily increasing. Owing to care in curing, the Western seed is often of the very best quality.

The seed of Kentucky blue grass is harvested by stripping the seed from the panicles with either a comb or a rotary stripper. The rough-stripped seed contains portions of the stems of the blue grass, weeds, leaves, and other rubbish. The entire mass is put into sacks and carried to the curing ground, where it is spread out in windrows to cure. Here it must be frequently turned to prevent heating, because if this is not done the pile of seed and green stuff quickly attains a high degree of heat, and injury to the seed results. When dry, the seed is cleaned by specially constructed machinery, which removes the chaff and the wool and turns out clean and smooth seed of the grade known as "fancy." (Pl. XIX, fig. 1.)

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[1] Gilmore, J. S., Report of the Kansas State Board of Agriculture for the quarter ending March, 1900.

[2] For fuller account, see Bul. No. 19, Bureau of Plant Industry, U. S. Dept. Agr., "Kentucky bluegrass seed: Harvesting, curing, and cleaning," by A. J. Pieters and Edgar Brown.

There are two grades in the trade, the fancy and the so-called extra clean, which consists of the chaff and light seed left after the fancy has been taken out. The seed is sold by sample, since all lots of fancy are not of the same quality. It is sometimes adulterated with Canada blue-grass seed. The weight of export fancy is 22 to 23 pounds per bushel, sometimes even going higher; but the domestic trade takes a lighter grade, weighing 19 pounds, more or less, to the bushel.

REDTOP.

Most of the redtop seed is produced in the southern part of Illinois, while some seedsmen report that a part of their supply comes from New Jersey. The seed is harvested during July, and in two ways—some still employ mowing machines, cutting the grass as hay and cocking or stacking after the grass is dry, while the new method is to harvest the seed by stripping with a rotary stripper like the one used for harvesting the blue-grass seed. When the new method is used, the grass is subsequently cut for hay, and the seed is thrashed in a grain thrasher, just as is done when the grass is cut by the old method. In thrashing, the wind is entirely shut off and suitable riddles are put in.

When the seed is thrashed, it contains a certain proportion of clean hulled seed, some good seed with the hull on, and some chaff. There is also a variable percentage of timothy, clover, and weed seeds. The farmers do not, as a rule, attempt to separate the "fancy" seed, as the clean-hulled seed is called, from the balance of the crop, but sell the whole to cleaners, who separate the different grades of redtop from the other seeds and chaff. The good seed in the hull is known as "prime" seed.

BEARDLESS BROME GRASS.

The Northwest is rapidly becoming a source of supply for the seed of beardless brome grass (*Bromus inermis*), although much is still imported. The seed is grown in Minnesota, the Dakotas, Oregon, Idaho, and Washington, as well as in the British territories to the north of these States. The seed is harvested when fully ripe, although care is taken to cut before the seed begins to shatter. Harvesting is done with a self-binder, set so as to cut high, and thus take in as little of the leaves as possible. When well dried, the seed is thrashed in a wheat separator, using an oat sieve and shutting off most of the wind. Some claim to use special devices, but if the seed is allowed to become well ripened before harvesting, it can be thoroughly cleaned in an ordinary separator. Samples of Idaho seed have been received that were more than 90 per cent pure, and others grown in North Dakota during the present season contained 97.5 per cent pure seed, 94 per cent of which germinated.

The amount of seed secured per acre varies much, some growers reporting 150 to 600 pounds, while others give 10 to 300 pounds as the

range. According to the tests at the Minnesota experiment station, it costs about 10 to 12 cents per bushel to thrash the seed. As there is no established grade, the seed is sold by sample, and the price varies widely, there being no constant and well-defined relation between quality and price.

MILLETS.

The different varieties of millet are grown for seed in many States in the South and West, from Georgia through Tennessee, Indiana, and Illinois to Wisconsin and Minnesota on the north, and as far as Kansas, Nebraska, and Texas to the west and southwest. A little is also produced in Oregon, but almost wholly on special contracts with dealers. This is also the case in Pennsylvania and Massachusetts, where some dealers grow their seed of Japanese millet on contract.

Although the general range is so wide, all varieties are not grown throughout this entire range. Pearl millet is largely a Georgia product. The headquarters for German millet is in Tennessee, but Texas produces some, and it is also grown in other States, notably Indiana, Illinois, Nebraska, and Kansas, where also the common millet is grown. Some seed of the latter variety comes from Wisconsin, Minnesota, and Michigan.

The German millet seed grown in Tennessee and in Texas is more highly valued in the trade than that of the same variety from the North and West. It is generally believed by seedsmen that the more rounded seed from Tennessee will produce a better crop than the somewhat elongated Western product. At any rate, higher prices are willingly paid for Southern seed, and dealers not sufficiently familiar with its appearance are sometimes imposed upon by having Western seed delivered to them at the price of Southern. It is impossible at present to decide how well founded is the trade belief in the superiority of Southern-grown seed, and the fact is recorded here simply because it has an important bearing on the price.

The harvesting and cleaning of millet seed do not differ much from the same operations in the case of wheat. The crop is cut with a self-binder as soon as ripe, to prevent loss of seed by shattering. When dry, the seed is separated by a grain thrasher. It is sold both by grade and by sample.

SORGHUMS.

Under this title we include all the varieties of *Sorghum vulgare*, such as Kafir corn, Milo maize, Jerusalem corn, Dhoura, Early Amber cane, Orange cane, and what is more generally known as sorghum. These varieties are grown more or less throughout the Central United States from Ohio to Kansas and from Georgia to Texas, special strains of early varieties being raised in the more Northern States. The principal seed-producing States are Kansas, Nebraska, and Iowa.

The method of harvesting and cleaning is essentially the same for all varieties, and is described for Kafir corn by J. G. Haney.[1] (Pl. XX, fig. 1.)

When fodder as well as seed is wanted, the stalks are cut, preferably with a corn binder, but when only the seed is desired, a header is used, which takes off the heads and a small portion of the stalks. Thrashing is done with a grain separator. If the entire stalk has been cut with a binder, the bundles are thrust for a moment into the cylinder, which removes the grain, and the stalks are taken out and thrown aside. A common method is to cut the heads from the stalks before thrashing, using a broadax or a knife on a block connected with a wagon box, or arranged in any other convenient way. The heads are then run through a separator the same as those that have been headed in the field. (Pl. XX, fig. 2.) Care is taken that the seed does not heat, which it is very likely to do when stored in sacks, and by which the vitality is quickly injured. The crop varies from 20 to 75 bushels per acre, even more being sometimes reported. The seed is sold by sample, and is usually recleaned by dealers, who claim to suffer a 5 per cent loss in cleaning, some even reporting 15 per cent in certain cases.

JOHNSON GRASS AND TEOSINTE.

Johnson grass is another species of sorghum (*Sorghum halepense*), and is known by various names, as Evergreen millet, Mean's grass, Guinea grass, Green Valley grass, and Cuba grass. The seed is largely a Texas product, but is also saved in Louisiana, Mississippi, and Alabama. It is harvested early in July with a self-binder, shocked, and thrashed with a grain thrasher. The seed is not usually recleaned by growers, being considered clean enough directly from the thrasher, though jobbers often reclean seed and claim that they lose 5 per cent in cleaning. An average crop is from 8 to 10 bushels per acre, and two crops of hay are subsequently taken from the land. If the conditions are favorable, a second crop of seed may be secured, which ripens September 1 or later, but this crop is uncertain, and is not depended upon. The straw left after thrashing the seed has some feeding value, and sells for 75 per cent of the price of regular hay. The seed is sold by sample.

The teosinte seed raised in the United States is exclusively Florida-grown, the extreme southern part of the State supplying nearly all the seed sold in this country. Foreign seedsmen have their seed grown in Egypt, and some is said to be grown on the plains of Algiers. In Florida the plants are grown in rows, and are sometimes cut once or twice before being allowed to produce seed. The seed ripens in

[1] Report of Kansas State Board of Agriculture for the quarter ending March, 1900.

December, and is thrashed with a regular grain thrasher. It is sold by sample, and is recleaned by dealers, who claim to lose about 5 per cent in the process.

LESS IMPORTANT AND FANCY GRASSES.

The grasses filling less important places in the economy of the American farm are mostly imported. Canada blue grass is raised along the northern shore of Lake Erie and some in New York State. The Canadian seed is almost all sold in the United States, the greater portion being used to adulterate the seed of Kentucky blue grass.

English and Italian rye-grass seed are imported from Ireland and Scotland, some being also raised in Germany and France.

The seed of rescue grass (*Bromus unioloides*) is produced in Texas, in Louisiana, and perhaps in Georgia, although Georgia rescue has lately been confounded with cheat (*Bromus secalinus*), which has been sold as Arctic, or rescue, grass. In Texas the yield is about 40 to 50 bushels per acre. The grass is cut with a mower, raked into windrows, and cleaned with a flail. The seed is sold by sample. Texas blue-grass seed (*Poa arachnifera*) also comes from the same county (Ellis) that produces the rescue-grass seed. The former is all gathered and rubbed by hand, hence the high price of the seed. This grass is more frequently propagated by sets, which are grown in Georgia and Louisiana. Tall meadow oat-grass seed is grown in Virginia and Oregon.

The seed of the so-called fancy grasses and of Bermuda grass is imported, the latter from Australia, the others from different European countries. The seeds are mostly gathered by hand and in small quantities in meadows, woods, and fields. Some of these seeds are raised to a certain extent in the United States, but the demand for them is not enough to warrant their production in commercial quantities.

MISCELLANEOUS AGRICULTURAL SEEDS.

In this class we include a few important staples, as cotton, tobacco, rape, flax, hemp, and sugar beet, and some minor crops, as broom corn, wild rice, saltbush, and pumpkin.

Cotton seed is produced in all the Southern States, and is usually sold, without grade or sample, being used for seed just as it leaves the gin freed from the lint. Commonly, no selection is practiced, and seed is planted frequently without even the name of the variety being known. More careful growers, however, plant a few acres each year for seed purposes. This patch receives the best of care; the cotton from the plants so grown is ginned separately and the seed is used the

following year. Besides this, a sufficient number of plants to plant the seed patch again are specially selected, and the seed they produce is planted to grow the seed crop of the next year. A great deal of special breeding is now going on among cotton experts, but such careful methods have not yet come into general use.

Tobacco seed is grown commercially in Virginia, but the best tobacco growers save their own seed. The tobacco produced in all the important tobacco sections has a character of its own, to preserve which the growers must use seed saved from selected plants grown in the locality where the tobacco is to be raised. Maryland farmers would not think of using any but their own seed to produce the particular kind of tobacco they grow. In Pennsylvania, the Havana tobacco has taken on a character of its own, and imported seed can not be used the first year for producing a crop. Not till the third generation can the seed be depended upon to yield a crop equal to the regular Pennsylvania Havana, and each year thereafter the grower saves his own seed from selected plants.[1]

The Florida-grown Sumatra tobacco is preferably raised from seed taken from the first or second generation after importing the seed. Careful men save enough of the seed of these crops to last for ten years, hanging it up in bags, and using it year after year. The seed retains its vitality and produces better tobacco than seed saved from a later generation.[1]

Hemp seed is raised in Kentucky, Missouri, and eastern Kansas, most of it being, however, sold as bird seed. When hemp is to be grown for seed it is planted in hills 42 to 48 inches apart, and is cultivated like corn. It is sometimes "topped" to make it spread and produce more seed. After the male plants have shed their pollen they are cut out. The seed is thrashed with a flail in a wagon box or any other convenient place, or beaten out over sheets of cloth spread on the ground. Much seed is also produced by plants grown for the fiber. This is known as "lint" seed, and is light and inferior in quality. It is not used for seed purposes except in years of short crops, when the heaviest of the lint seed is cleaned out to be sold for seed. Growers commonly prefer a small dark-colored seed. (Pl. XXI.)

Small quantities of seed are annually imported from China, France, and Italy. The seed from China is mostly received through missionaries in small packets, and is highly prized. The first year it is sown for seed purposes exclusively, and does not at first yield as good fiber

[1] Whitney, Milton, Chief, Bureau of Soils, U. S. Department of Agriculture.

FIG. 1.—HARVESTING SORGHUM SEED IN NEBRASKA.

FIG. 2.—CUTTING THE HEADS FROM SORGHUM AND STACKING IT FOR SEED IN NEBRASKA.

FIG. 1.—BEATING OUT HEMP SEED IN KENTUCKY.
[Photograph by Prof. H. Garman.]

FIG. 2.—HEMP GROWING FOR SEED IN KENTUCKY.

as the American plant. The Chinese variety rapidly becomes acclimated, and the seeds of the second and third generations produce plants with fiber of the best quality. The occasional importation of the Chinese seed is necessary to keep up the quality of the American hemp, which tends to deteriorate.

FLAX.

Flax seed is produced in several Northwestern States, but it is mostly used for crushing. The usual practice of farmers is to save out enough seed for the following spring's sowing. Such seed is often selected by the fanning mill, or the common run of the market seed may be used. The seed grown in the North and sold on the Chicago market for crushing produces a plant with inferior fiber, but some farmers use their own seed rather than pay the extra price for imported seed. Seed from flax grown for fiber in Michigan is thrashed and used for seeding, but little selection is practiced, and the plants degenerate. To save this seed the flax plants are pulled, tied in bundles about 4 inches in diameter, and stood in shocks like wheat until dry. The seed is then thrashed by passing the seed ends between smooth rollers, which crush the capsules and partly break them off. Other machinery is used to complete the thrashing, and the seed is cleaned with a fanning mill. The best fiber is produced from plants grown one or two generations in this country from seed imported from Riga, Russia.[1]

RAPE, PUMPKIN, SALTBUSH.

The use of rape for sheep and hog pasture is constantly increasing, and the seed used east of the Rocky Mountains is all imported, mostly from England. In Oregon, rape seed is being grown, and although there is not yet enough to supply the home demand the prospects are favorable for an increase of the output. The first seed crop placed on the market was grown in 1900, but some farmers had been growing their seed for several years. The rape to be saved for seed is pastured with sheep until March, when the flower stalks begin to come. The crop is harvested with a mower or harvester, but is not bound, and the seed is thrashed out by a common thrasher. The Oregon Agricultural College has grown rape seed, harvesting (during 1901) 2,331 pounds from 2.17 acres. The seed ripens from the latter part of May to the middle of June. Louisiana farmers also grow some rape seed, but only for their own use.

Field pumpkins are grown in many States, and most farmers save some seed for their own use. The seed grown for the trade is, however, supplied by regular growers, who raise the pumpkins on their own farms or by contract with neighboring farmers. The average

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[1] Dewey, L. H., Assistant Botanist, U. S. Department of Agriculture.

yield is 3 bushels per acre, a bushel being 28 pounds. The seed is harvested in October and November, and is removed from the pumpkins by hand. It is sold by sample, the price ranging from $2\frac{1}{2}$ to 5 cents per pound. (Pl. XIX, fig. 2.)

The seed of the Australian saltbush comes partly from Australia, and the remainder is grown in the Western States, chiefly in California. In the latter State the seed is harvested by hand in August and cleaned by the growers. It is sold by sample.

WILD RICE, BROOM CORN, ALFILARIA.

Wild rice (*Zizania aquatica*) is gathered in the swamps about the lakes in northern Minnesota and Wisconsin. The Indians go out in canoes early in September and beat the seed off into the boats. It is later recleaned and sold by sample.

Broom-corn seed is largely grown in Iowa. It is harvested in September and the seed removed by a special machine called a stripper. The crop runs from 1,500 to 2,500 pounds per acre and is recleaned, the loss being from 20 to 25 per cent. As soon as the seed is dry it is placed on the market and sold by sample.

Alfilaria (*Erodium cicutarium*), which is coming into use as a forage plant in the Pacific coast States, produces seed wherever it is grown, but the seeds are difficult to collect free from weeds. They are always gathered by hand from the ground in May or June, according to the season. The seed is sold by sample, and whether or not it needs recleaning depends upon the time it is gathered.

SUGAR-BEET SEED.

Sugar-beet seed is practically all imported. Some is produced in Utah and some in California, and a few of the experiment stations and some of the sugar-beet manufacturers have made more or less successful attempts to grow good seed. In Washington State beet seed has been raised from beets taken without chemical selection from fields that yielded an average factory return of 20 per cent, some beets going as high as 24 per cent. This seed in turn yielded beets for which the factory returns showed 19.9 per cent sugar and 88 per cent purity, while beets in the same field from best imported seed contained 18.59 per cent sugar, with a purity of 85.67. So far, however, these results have only just passed the experimental stage, and the amount of seed produced in the United States is not large enough to materially affect the importation of German and French seed.

Sugar-beet-seed growing requires more skill and care than does the growing of any other agricultural seed, and there are few even of the finer flower and vegetable seeds that require so much attention and labor to produce. High-grade seed is grown only from mother beets,

every one of which is examined for shape, character of leaf, and keeping quality, and tested for sugar content. On large farms, where thousands of pounds of seed are grown each year, there are well-

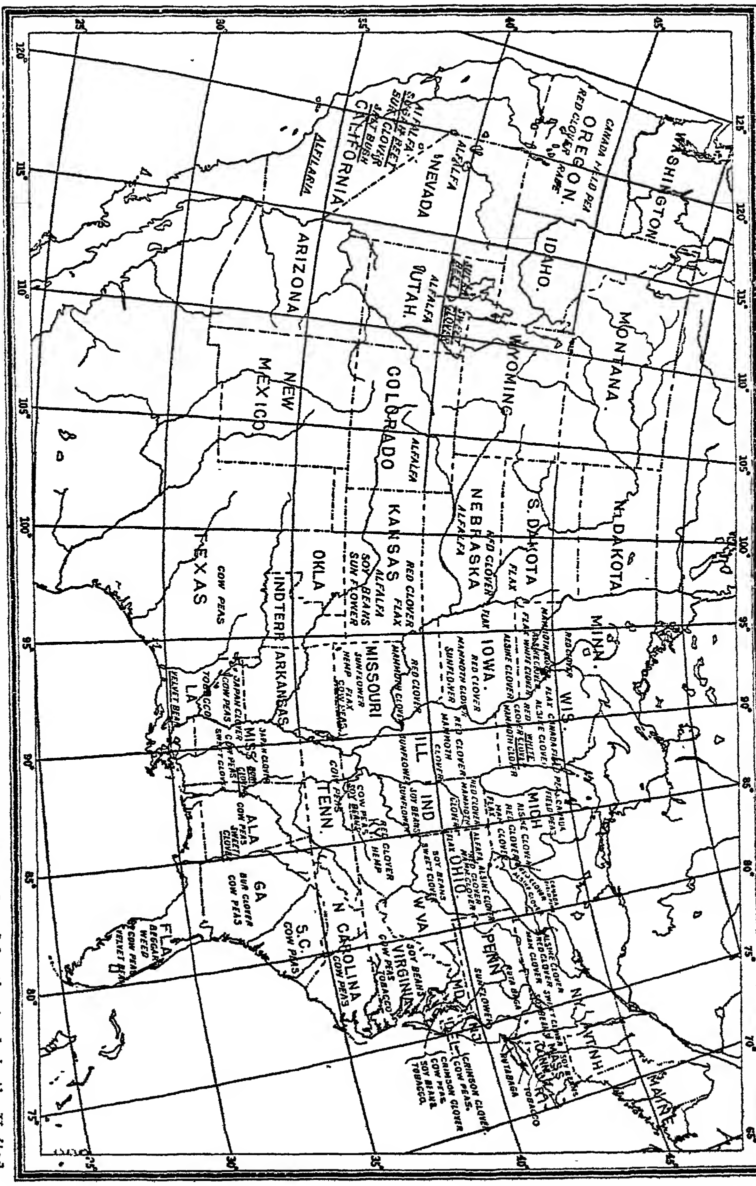


FIG. 22.—States where the seeds of leguminous forage plants and of some other economic plants are produced for the trade in the United States and Canada.

equipped chemical laboratories in which every beet is tested before it is planted. This is done by taking a core out of the beet and subjecting it to an analysis for sugar content. Only those beets that contain

a sufficiently high percentage of sugar are used as mother beets. The seed from the mother beets is planted the next year and the resulting plants allowed to grow thickly in the row. A large number of under-

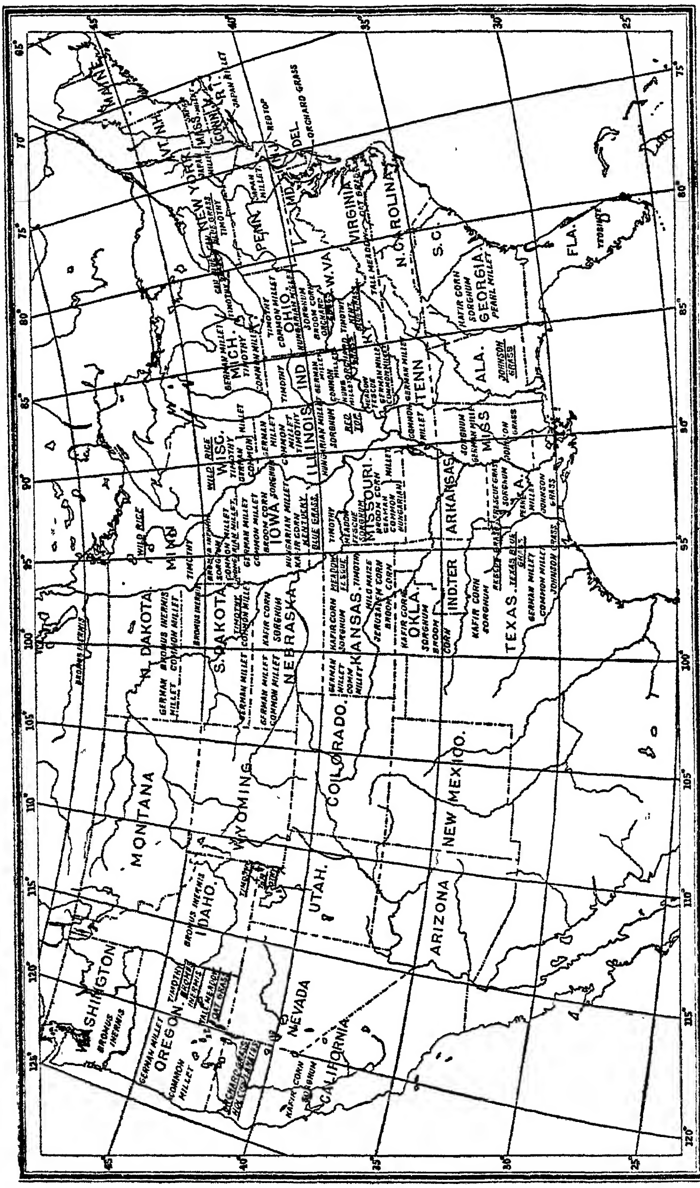


FIG. 23.—States where the seeds of grasses and grass-like plants are grown for the trade in the United States and Canada.

sized beets are grown per acre in this way. These are dug, stored, and planted out the following spring to produce seed for the trade. This is the common practice abroad, but it is claimed that better beets

could be grown if the seed from the tested beets were used to produce the beets for the factory. By the common practice, the tested beets really become grandmothers, the mother beets being small, inferior roots, designed wholly for seed production.

Sugar-beet seed is sold on guaranty and is carefully tested for moisture content, purity, and germination. If the seed does not reach a certain standard in regard to these points, it may be rejected or the seller may submit to a pro rata reduction in the price. These tests are made at stations established for the purpose of testing seeds, and according to rules and regulations adopted by various societies or stations. There are a number of standards for the quality of beet seed and several ways of determining the real value of a sample. The best known and most important are the Magdeburg and the Vienna standards. The former have been adopted by the German Beet Sugar Association and are recognized throughout Germany. Probably all of the seed sent to the United States is sold under the Magdeburg rules. The Vienna standards are in force in Austria. The germination tests to determine the value of the seed are made under such conditions that the temperature and moisture may be controlled, the former being kept for eighteen hours at 20° C. and for six hours at 30° C. Since the most important matter, the quality of the beets that will be produced, can not be determined by an examination of the seed, careful buyers deal only with growers of established reputation on whose word they may depend for the most important information regarding the quality of the seed.

Charting the Distribution of Seed-producing Centers.

It is impossible to draw a hard and fast line between the production of seed for the farmer's own use with the sale of a small surplus and the sale of a volume of seed sufficiently large to influence the market; and it would be impracticable to show all the places where seed is saved for seed purposes. An attempt has therefore been made to indicate the States or parts of States from which the seed trade draws the principal supply of seed of each variety. The information on which the charts (figs. 22 and 23) were prepared was secured partly as a result of personal observation and partly through the kindness of seedsmen and directors of experiment stations and others connected with the stations, and the charts are believed to be as full and as accurate as the present condition of our knowledge permits. It is not improbable that certain sections have been overlooked or that in some cases a kind of seed has been credited to a State in which not enough of that seed is grown to justify such credit, but on the whole the charts give a reasonably correct survey of where the seeds of forage and some other economic plants are grown for the seed trade.

The cereals and cotton have been omitted, since the seed of these plants is saved and sold wherever the crop is grown.

On the charts an attempt has been made in some cases to indicate, approximately, the part of the State in which a certain seed is grown. In all such cases the name of the seed is underscored. In all other cases the location of a name is a matter of convenience, and does not mean that the production of the seed is confined to the part of the State on which the name happens to stand.

THE PRAIRIE DOG OF THE GREAT PLAINS.

By C. Hart Merriam,
Chief of Division of Biological Survey.

INTRODUCTION.

In crossing the United States by any of the transcontinental railways the traveler who looks out from the car window on the second day westward from Chicago is sure to have his attention arrested by colonies of small animals about the size of cottontail rabbits. These animals are prairie dogs. Some stand erect at the mouths of their burrows, view-

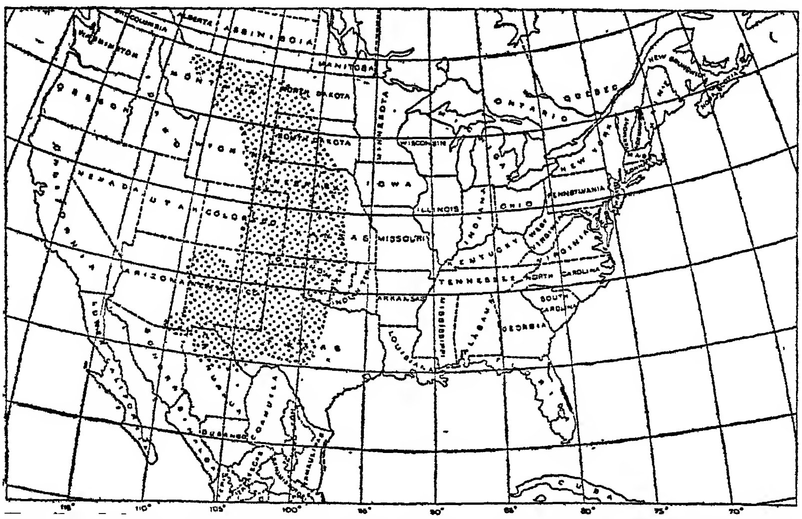


Fig. 24.—Distribution of plains prairie dog (*Cynomys ludovicianus*): The occupied area is marked with dots.

ing the passing train; others are engaged in feeding or running to and fro about the colony. The land they occupy is the broad expanse of level and slightly rolling semidesert country known as the Great Plains, a vast tract which stretches from the Rocky Mountains easterly to the western edge of the Mississippi Valley, and from Montana and North Dakota southward to Texas and Mexico. (See fig. 24.) The plains are treeless, except along the streams, and the ground is sparsely covered with grass and other small plants, which are green in early spring and brown the greater part of the year.

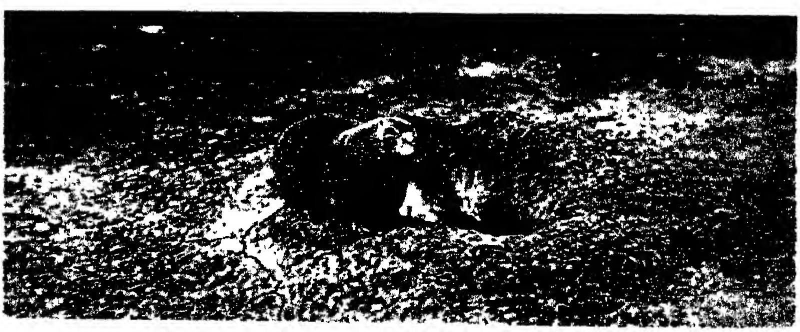
The prairie dog loves sunshine and a dry atmosphere, and in ranging easterly from the arid plains toward the humid prairies of the Mississippi Valley becomes less and less numerous, till between the ninety-seventh and ninety-eighth meridians he disappears altogether. Not even the luxurious vegetation of the prairies is sufficiently attractive to lure him into the humid belt adjoining his chosen home. That he is fond of rich vegetation and prefers it to the dry bunch grass of the plains is shown by his great destructiveness to alfalfa, grain, and other crops grown on irrigated lands within his range. This is an important illustration of the law that in fixing the limits of distribution of animals climatic factors are even more potent than food.

The prairie dog is preeminently a social animal, living in colonies which vary in extent from a few acres to thousands of square miles and inhabited by thousands, and in some cases millions, of animals. Colonies 20 to 30 miles in length are not rare, and in Texas one is known which measures about 250 miles one way by 100 to 150 the other, covering an area of about 25,000 square miles. The number of holes in use on each acre varies from a few to upward of a hundred, and probably averages at least 25. At Alma, Nebr., W. H. Osgood found the number ranging from 35 to 64, and on an alfalfa field near Carlsbad, N. Mex., Vernon Bailey found 1,009 on 20 acres, or 50 to the acre. In old towns many holes are abandoned, or used only as refuges, so that it is difficult to ascertain how many animals live in a stated number of holes. Another difficulty lies in the varying number of animals in the occupied holes, for in winter and early spring the usual number is two (a pair), while after the birth of the young the number is at least quadrupled, and then decreases with the advance of the season, as the young are killed by enemies. It is certainly a conservative estimate to assume the average number of animals per acre to be 25. On this assumption, the number of prairie dogs in the great Texas colony must be at least 400,000,000.

According to the formula for determining the relative quantities of food consumed by animals of different sizes (kindly given me by Prof. W. W. Cooke), 32 prairie dogs consume as much grass as 1 sheep, and 256 prairie dogs as much as 1 cow. On this basis the grass annually eaten by these pests in the great Texas colony would support 1,562,500 head of cattle. Hence, it is no wonder that the annual loss from prairie dogs is said to range from 50 to 75 per cent of the producing capacity of the land and to aggregate millions of dollars.

GENERAL HABITS OF PRAIRIE DOGS.

When a person approaches a dog town the animals see him a long way off and keep a close watch on his movements. As he comes nearer an alarm note is sounded, at which those away from their burrows rush to the entrance mounds, where they sit or stand erect, nervously twitching



PHOTOGRAPHED BY C. HART MERRIAM. HELIOTYPE CO., BOSTON.

THE PLAINS PRAIRIE DOG (CYNOMYS LUDOVICIANUS).

their tails and chattering or barking excitedly. If he continues to move toward them the excitement increases, and most of the animals on the near side of the colony plunge headlong into their burrows. Some withdraw more slowly, and for some time their heads and eyes may be seen peering up from the funnel-shaped openings of the mounds. Those near by are usually silent, while those at a little distance continue to scold and chatter. This chattering or barking, as it is usually called, can often be heard after the animals have gone down out of sight in their holes. (Pl. XXII.)

Along railroads the animals have become so accustomed to the trains that they no longer take fright as the great noisy engine rushes madly by, and they are best observed, perhaps, from the windows of passing trains. Their indifference at such times is amazing. I have often watched them from the "Overland Limited," some standing erect on their mounds; others chasing one another about or quietly feeding within 40 or 50 feet of the roaring, rushing train, without showing the least outward sign that anything unusual was happening. One would think the fury and deafening roar would be too much for their nerves, but they appear to regard it with absolute unconcern. It is extraordinary how soon animals lose their fear of naturally terrifying objects when such objects come and go frequently without doing them bodily violence.

In summer, prairie dogs are most active mornings and evenings, usually remaining in their holes during the hotter part of the day. In fall they become very fat, and apparently sleep a good deal; at least, they are much less regular and are less frequently seen. In winter, in the southern part of their range, they may be seen nearly every day unless it is stormy. Thus, in Texas and New Mexico they are said to come out in good weather shortly after sunrise, even at times when the temperature is below freezing. On the northern plains they hibernate irregularly, but still appear at intervals. The periods of hibernation are probably determined by storms and by the length of time the ground is covered with snow, for in Montana and Wyoming they have been known to appear, in places where the ground was bare, on calm sunshiny days in midwinter when the mercury stood at or below zero.

Prairie dogs, like the desert species of kangaroo rats, pocket mice, ground squirrels, and other rodents of arid regions, are able to live and thrive without drinking. In many places the only moisture they take into their systems is the small quantity contained in the dry grasses, seeds, and roots they eat. In arid western Texas they are abundant in places where the annual rainfall is slight and uncertain and where some years pass without any rain. With respect to the theory that their burrows are deep enough to reach water, it need only be said that in some of the dog towns artesian wells have been sunk to the depth of 1,000 feet without striking water.

TIME OF BIRTH AND NUMBER OF YOUNG.

The time of reproduction varies with the latitude and altitude, but exact information as to the dates of birth and the number of young in a litter in different parts of the plains is not at hand. In Texas the young are usually seen at the mouths of the holes in early May, while in North Dakota and Montana they rarely appear before the latter part of May or first week of June. The usual number of young seems to be four, but the cases in which the number is definitely known are few.

MOUNDS AND BURROWS.

The mouth of each burrow opens in the middle of a mound, which is usually a foot high and 3 or 4 feet in diameter (Pl. XXIII, fig. 1). The mound increases in size with age, those that have been used for many years attaining a height of 1½ or 2 feet and a diameter of 8 or 10 feet. The interior of the mound is funnel-shaped, forming an elevated crater-like rim around the entrance of the hole. This is pressed into form by the nose of the animal, as may be seen in Pl. XXIII, fig. 3, which shows prints of the nose all around the inside. After injury from rains or other causes the rim is repaired by scraping up the ground from outside (Pl. XXIII, fig. 2). Sometimes the repairs are made before rains, and some observers regard the animals as exceptionally clever weather prophets. Thus, Maj. H. W. Merrill states that whenever they are busy scraping the earth up around their burrows and pressing it into place with their noses rain is sure to follow in a very short time. The chief object of the elevated rim is to keep the water out of the burrows when the ground is flooded by sudden rains, as shown in Pl. XXIV, fig. 1. The ground immediately surrounding each burrow is usually cleared of small plants and kept clean and bare, and where burrows are near together the bare areas often join, so that in thickly populated colonies the ground is hard and smooth like a playground, and the animals are obliged to go some distance for food. This they dislike to do, lest they be pounced upon by enemies; hence, when the grass near their burrows has been consumed they dig new holes nearer the supply. It takes a long time for vegetation to regain a foothold on the hard floors of the dog towns, and the sites of old towns remain conspicuous for years after they are abandoned.

The holes go down for some distance at a very steep angle and then turn at nearly a right angle and continue horizontally, rising somewhat toward the end. The nests are in side chambers connecting with the horizontal part of the burrow, and usually, if not always, at a somewhat higher level (fig. 25, *H*). Recently, at Alma, Nebr., W. H. Osgood dug out a burrow, of which he made a careful diagram (fig. 25), accompanied by measurements. In this case the

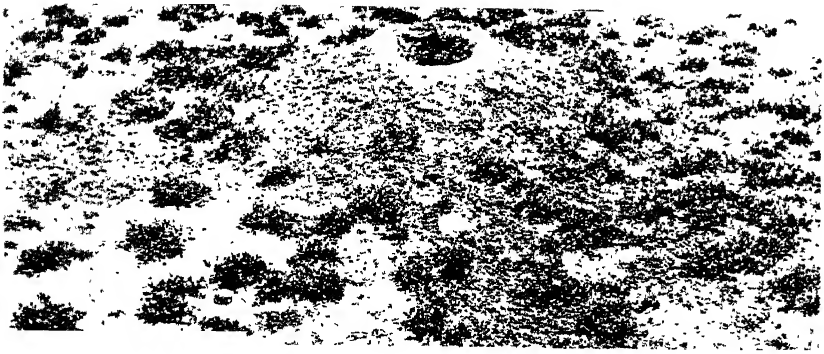
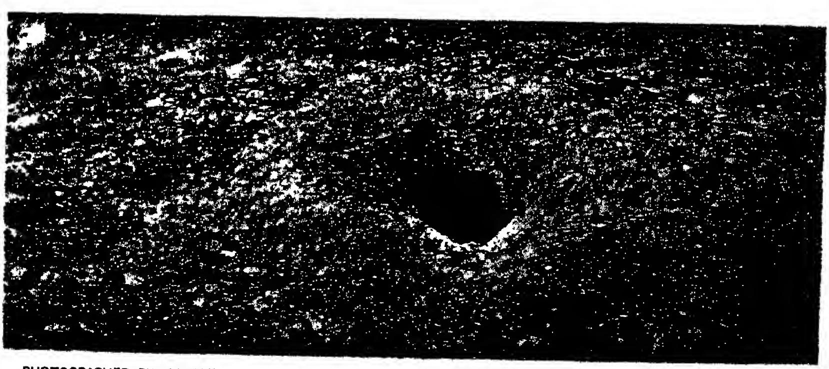


FIG. 1.—NORMAL MOUND IN NEW GROUND (AN ALFALFA FIELD).

FIG. 2.—MOUND REPAIRED BY SCRAPING UP EARTH FROM THE OUTSIDE.



PHOTOGRAPHED BY VERNON BAILEY. HELIOTYPE CO., BOSTON.

FIG. 3.—INSIDE OF RIM OF MOUND, SHOWING NOSE MARKS.

MOUNDS OF THE PLAINS PRAIRIE DOG.

burrow went down nearly vertically to a depth of 14½ feet below the surface, when it turned abruptly and became horizontal, as shown in the diagram. The horizontal part was 13½ feet in length. One-third of the horizontal part (the terminal 4 feet, *F*) and two old nests and passageways (*E*) were plugged with black earth brought in from

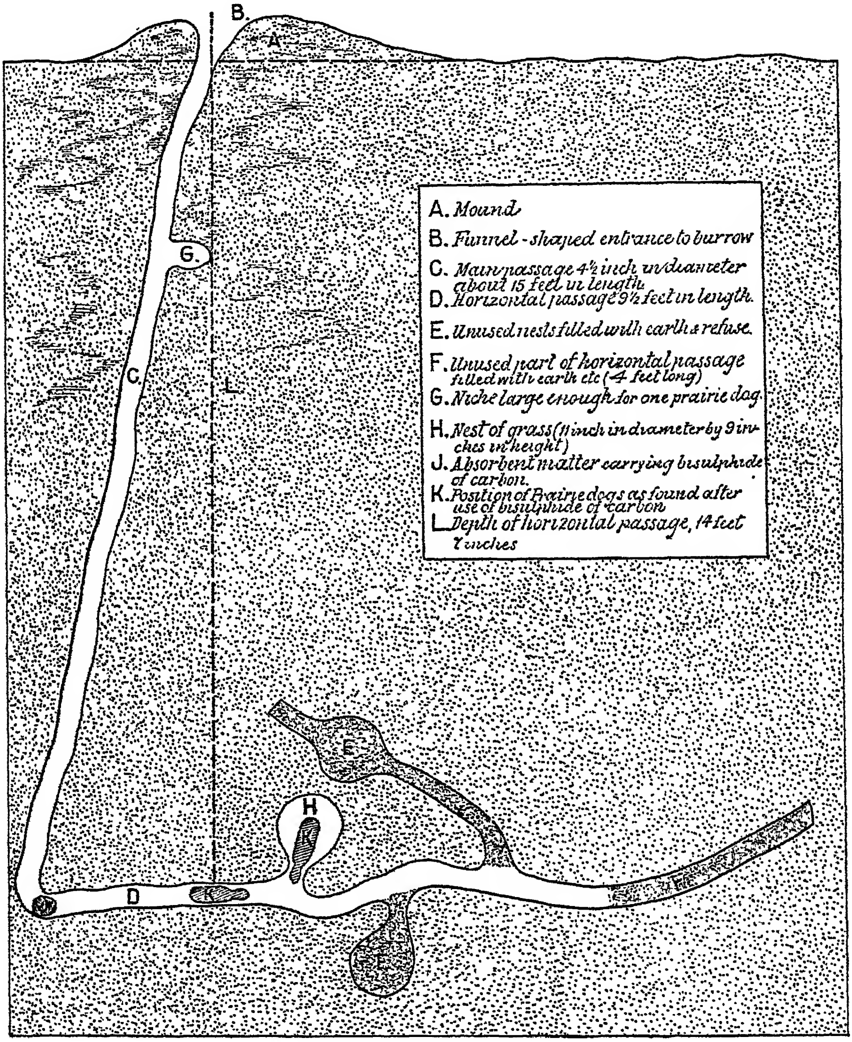


FIG. 25.—Prairie-dog burrow.

the surface layer, which was very different from the light-colored clayey earth in which the greater part of the burrow lay. Four or five feet below the entrance was a diverticulum, or short side passage (*G*), probably used as a place in which to turn around when the animals come back to take a look at the intruder before finally disappearing in

the bottoms of their burrows. It is also used, apparently, as a resting place where they bark and scold after retreating from the mouths of the burrows. As elsewhere noted, they are often heard barking after they have gone in. The burrow was opened the day after bisulphide of carbon had been used for destroying the animals, and the material carrying the bisulphide was found at the bottom of the vertical part, just where the horizontal part turns off. Two dead animals were found, one in the horizontal part, the other in the nest, as indicated by the letter *K* in the diagram.

NATURAL ENEMIES.

The prairie dog has several mortal enemies which, when not interfered with by man, usually serve to hold its numbers in check. The most inveterate of these appear to be the coyote, badger, black-footed ferret, and rattlesnake. Their methods of attack differ widely.

The coyote sneaks up to the borders of a colony, hiding behind straggling tufts of vegetation and depending largely on his protective coloration for concealment. He usually approaches when the animals are in their burrows, and strives to reach some object behind which he may hide and lie in wait until some unwary inhabitant comes out to feed, when by a quick rush it may be headed off and caught.

The badger usually drives his prey into its burrow and then deliberately digs it out. He is for his size one of the most powerful animals in the world. His foreclaws are long and strong, and his sense of smell is highly developed. On sniffing a prairie dog or gopher in its burrow, he simply bores down to his victim, which has no possible means of escape.

The black-footed ferret is built like a weasel, and though much larger, is small enough to enter and traverse freely the burrows of prairie dogs, so that he is able to pursue them to the ends of their holes and capture them with absolute certainty. He is, therefore, one of their most relentless and terrible enemies, and if sufficiently abundant would quickly exterminate all the inhabitants of the largest colonies.

The rattlesnake, like the ferret, glides silently into the hole, but is said to confine his attentions to the young, which he takes from the nest or seizes in the passageways. Travelers on the plains, from the time of Lewis and Clark to the present day, speak of finding young prairie dogs in the stomachs of rattlers killed in the dog towns. The usual number so found appears to be one or two, but Dr. J. A. Allen states that he once found three. One author claims that in Texas these reptiles live almost wholly on the young of the prairie dog and do more, perhaps, to keep down the numbers than all other agencies. This writer continues:

> A curious thing about the snake and the dog is that each is mortally afraid of the other. The dog is afraid of being eaten by the snake, and the snake is afraid of

being entombed by the dog. If the mother of the young dogs, on a return to the home hole, finds that a snake has intruded, she at once sets up a peculiar cry or bark, to which all the citizens of the town at once respond. They gather about the hole, and in a moment all are at work filling it up. The quickness with which they can do this is remarkable. When the hole is filled they butt and pack the dirt in the mouth of the hole till it is almost as hard as the prairie adjacent. There is no chance for an escape of the invader. He is sealed up in his tomb. The snake understands this danger, and is prepared to escape from it on the least warning. A handful of dirt thrown in a hole where the snake is will bring him with all speed out of the hole, because he is under the impression that the dogs are about to seal him up.[1]

There are other enemies also, such as cougars or mountain lions, bobcats, eagles, hawks, and owls, but most of them are not sufficiently abundant on the Great Plains to be regarded as important factors in holding the prairie dog in check. Still, in some localities, hawks and owls kill large numbers of the young. They should be protected and encouraged.

RECENT INCREASE AND SPREAD OF PRAIRIE DOGS.

Formerly the area of available land in proportion to the population was so great that little attention was paid to such pests as prairie dogs and gophers. But in recent years the development of improved methods of farming, including irrigation and artesian water supply, has led ranchmen to push farther and farther westward over the semi-arid plains, until agriculture and stock raising have invaded most parts of the prairie dog's domain, the land holdings have decreased in size and increased in value, and the depredations of pests are more keenly felt.

On many parts of the plains prairie dogs are now more abundant than formerly and their colonies have overspread extensive areas previously unoccupied. This is due to the coming of the white man, whose presence favors their multiplication in two ways—(1) by increasing the food supply, and (2) by decreasing the animal's natural enemies. The white man cultivates the soil and thus enables it to support a larger number of animals than formerly; at the same time he wages warfare against the coyotes, badgers, hawks, owls, snakes, and other predatory animals which had previously held the prairie dogs in check. Thus favored, the prairie dogs have multiplied until they have become one of the most pernicious enemies to agriculture. The increase of late years is well known to ranchmen on the plains, but for the information of others a few definite instances recently collected by my assistants may be of interest.

Richard Harrison, of Blunt, S. Dak., states that ten years ago there were possibly 25 occupied burrows on his land; the animals increased slowly and six years ago not more than 10 acres were infested. Since then the increase has been so rapid that at present the area they occupy covers about 160 acres.

[1] American Field, p. 194, March 11, 1899.

O. E. McArthur, also of Blunt, S. Dak., states that about fifteen years ago his children noticed two or three burrows about a mile from his house, and that no particular attention was paid to the inmates, which, during the next few years, increased slowly. A little later, however, they spread over so much land that their multiplication became a matter for serious alarm. At present they occupy a full quarter section (160 acres), having surrounded Mr. McArthur's house and taken possession of all the land near it.

A cattle ranch in Logan County, Kans., which ten years ago pastured a thousand head of cattle, will barely support 500 at present, owing to the great increase in prairie dogs, which have overrun the range. Practically, the whole of the southern half of Logan County is now one continuous dog town, estimated to cover about 300 square miles. In the past decade the population of this area has decreased, a post-office (Elkader) has been abolished, and many homes have been vacated, the result, it is said, of the great increase in prairie dogs.

At Carlsbad, in the Pecos Valley, New Mexico, in September, 1901, Vernon Bailey studied a colony of prairie dogs which completely covered a 20-acre alfalfa field, 4 or 5 acres in each of two adjoining fields, and several acres of prairie. He was told that this large colony had spread in three years from a small one in a corner of the alfalfa field.

E. W. Nelson states that when he and his brother located ranches in a mountain valley in eastern Arizona in 1884, the only prairie dogs in the vicinity were a colony 3 miles distant, inaccessible except by way of a narrow box canyon. About three years later a prairie dog's burrow was found on the ranch, after which the animals multiplied steadily, until in 1895 they occupied a large part of the valley.

Complaints are constantly received of the spread of the pests on farm lands adjoining Government, railroad, school, and other lands, over which the inhabitants have no jurisdiction. This is a very serious evil, and one with which it is exceedingly difficult to cope.

FOOD.

The normal food of the prairie dog is grass, chiefly the bunch grass of the plains. In addition to this, grass roots, other plants, seeds, and sometimes insects are eaten.

DESTRUCTIVENESS.

The damage done by prairie dogs consists in the loss of grass and other crops eaten, or buried under the mounds; in the accidental drainage of irrigation ditches,[1] and in the danger to stock from stum-

[1] In Stillwater Valley, Montana, an irrigating ditch on a side hill was tapped by a prairie dog burrow and the water came out 50 feet lower down on the slope. The hole was twice stopped and the ditch moved a little, but the break recurred, and it was finally necessary to dig a new ditch around the washout.

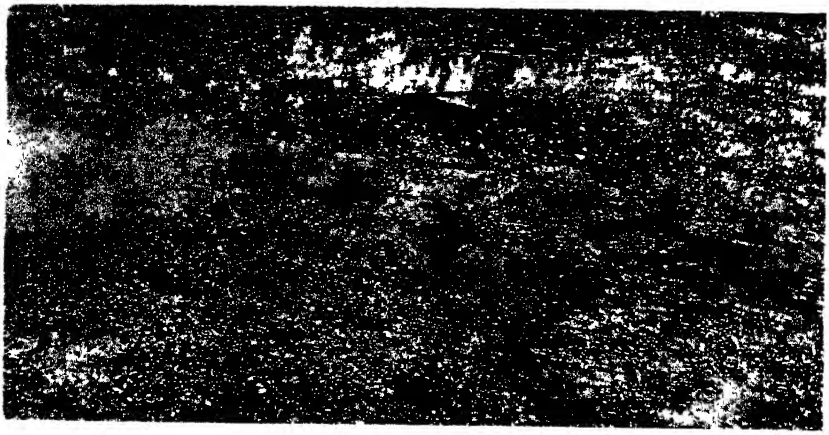


FIG. 1.—MOUND IN FLOODED GROUND, SHOWING PROTECTION FROM RAINS.

FIG. 2.—NEW MOUND IN ALFALFA FIELD.

PHOTOGRAPHED BY V. BAILEY AND W. H. OSGOOD. HELIOTYPE CO., BOSTON.

FIG. 3.—NEW MOUND IN ALFALFA FIELD.

MOUNDS OF THE PLAINS PRAIRIE DOG.

bling in the holes. Running horses often trip and break their legs, and riders are sometimes injured and even killed.

On ranch lands prairie dogs have proved destructive to a variety of crops, among which are alfalfa (Pl. XXIV, figs. 2 and 3), grain, potatoes, and sugar beets, and on grazing lands they are said to consume, or bury under their mounds, so much grass that the capacity of the land for supporting stock is reduced, as already noted, from 50 to 75 per cent. A prominent Texas newspaper recently published an editorial containing the following:

> No man who has not gone through the portions of Texas infested by prairie dogs can conceive the enormous ravages they have committed. Millions of acres of land once covered with nutritious grasses have been eaten off by these animals, until the land is naked and worthless, and will remain worthless so long as the prairie dog remains. They invade the farms and eat down the growing crops. Here and there individual effort has been made to destroy them, without avail, and their numbers steadily increase, until they are a menace to the prosperity of the land.

POPULAR INTEREST IN THE DESTRUCTION OF PRAIRIE DOGS.

The general apathy of a few years ago, when land was plentiful and of little value, has given place to widespread and active effort to rid the country of the pests. Wherever our field experiments have been made, from the Dakotas to Texas, the inhabitants were found fully awake as to the necessity for immediate action, and hundreds, if not thousands, of them had already expended time and money in single-handed efforts. The recent attempt of the National Government to ascertain the simplest and most efficient means of combating the evil has been received with universal approval. With one or two exceptions, our field men were granted free access to private lands, and in most instances were enthusiastically received and accorded every assistance and courtesy. In some cases, where the animals are rapidly increasing, the actual and prospective losses are so great that ranchmen expressed their willingness to pay for the destruction of the animals at a rate per acre exceeding the actual market value of the land.

METHODS OF DESTRUCTION.

In the case of prairie dogs, as in the case of gophers and ground squirrels, numerous remedies have been suggested and tried, most of which have met with a certain measure of success. Few, however, have proved available on a large scale. It is easy to destroy isolated animals, and to completely exterminate the inhabitants of small isolated colonies, but, as a rule, the problem confronting the sufferer from prairie dogs is one of larger dimensions; to cope with it successfully means the employment of measures and remedies that are simple, easily handled, available on a large scale, and last, but not least, not too costly (either for materials or labor) to be used over areas comprising thousands of acres. The cost on large ranches

should not exceed 18 cents per acre, and should fall as far short of this as possible.

Among the measures that succeed well enough on a small scale or under special conditions are trapping, drowning, destruction by domesticated ferrets, and capture in sand barrels and straw barrels placed over the holes. On a large scale, poisoning and fumigating have yielded the best results.

POISONING.

By poisoning is meant the administration of a poison or combination of poisons by means of some article of food which the animals will readily eat. The poisons most in favor are strychnine and cyanide of potassium. Phosphorus also has been used and is an ingredient of many of the poison mixtures sold in the stores. It is efficient, but its use is attended with danger, and it is not recommended by this Department.

Cyanide of potassium.—Cyanide of potassium kills quickly, and is an excellent poison, but it is sometimes difficult to administer, chiefly on account of its odor, which is offensive to most animals. Like phosphorus, it is dangerous to man, and must be handled with great care. It is said to lose its power when wet or exposed to the atmosphere. It has been administered in prunes and raisins, and (in combination with strychnine) is a component of the celebrated Peters mixture for poisoning grain, in which it is disguised by a coating of molasses, flavored with oil of anise.

Strychnine.—Strychnine is probably, all things considered, the best and most satisfactory poison now known for the destruction of prairie dogs. It can be obtained everywhere, usually at a moderate price, and its use is simple. The minimum dose necessary to kill prairie dogs is not known, but it is safe to say that the quantity recommended in the Peters formula (3 ounces to a bushel of wheat) is excessive. Two ounces is doubtless sufficient, and 1½ ounces is probably enough. (For ground squirrels, 1 ounce to the bushel of grain is ample.) The strychnine sulphate should be dissolved in warm water, in which the grain should be soaked for twenty-four or thirty-six hours, until all is absorbed. Some experimenters find this sufficient; others prefer to sweeten the grain by stirring in a quart or two of molasses and sprinkling with enough corn meal to prevent sticking. Some use corn meal alone, made into pellets, without any whole grain. Another way to administer strychnine is to introduce small quantities in prunes or raisins, in pieces of apple, carrot, or turnip, or on bread and butter. In the last case it is said that the strychnine should be sprinkled on buttered bread and then coated lightly with sirup, after which the bread is cut in small squares and placed around the burrows. The cost of strychnine sulphate, as customarily sold in small Western

towns, is $1.50 to $2 per ounce. It comes in 1-dram (⅛-ounce) bottles which usually retail for 25 cents. Assuming that 2 ounces is the quantity necessary to poison a bushel of grain, the poisoned grain would cost about $5 per bushel. Allowing a tablespoonful to be the average quantity necessary to scatter about each hole, and allowing 50 holes to the acre,[1] a bushel of grain will poison 40 acres, at a cost of 12½ cents per acre. A man can scatter poisoned grain over 50 acres or more per day; hence, if labor costs $1 per day, the expense per acre of putting out the poison would be 2 cents, which added to the above 12½ cents for materials, makes the total cost 14½ cents per acre. The first application of the poison, if carefully made in late winter or early spring when food is scarce, may be counted on to kill 75 to 80 per cent of the animals (and has been known to kill as high as 95 per cent), and this at a cost per acre of less than 15 cents. The second application, a week or two later, is aimed at the few remaining occupied holes, which should not average more than two or three to the acre, and the cost per acre should not exceed 1, or at most, 2 cents. If any animals remain, they may be killed by bisulphide of carbon, and in many cases it is better to do away with the second poisoning and use bisulphide to kill off those that are left after the first poisoning.

FUMIGATION.

By fumigation is meant the destruction of animals by fumes arising from substances thrown into the burrows, as bisulphide of carbon, or generated outside and forced in by mechanical appliances known as "fumigators." Fumigators are devices by means of which fumes from burning sulphur or other materials are pumped into the burrows. In parts of the West, particularly California, they have been used with success in killing gophers and ground squirrels. They have been successfully used also against prairie dogs, but their employment for this purpose does not appear to be gaining ground.

Bisulphide of carbon.—Bisulphide of carbon is a volatile liquid which rapidly loses its strength on exposure to the air, and should be kept in tightly corked bottles or cans, which, when used, should be immediately recorked. It is inflammable and highly explosive, and should never be opened in the vicinity of a light or fire. Its fumes are heavier than atmospheric air, and when introduced into burrows sink quickly to the bottom.

The method of application is exceedingly simple. The usual dose for prairie dogs is 1 ounce (about a tablespoonful). This quantity should be poured on some absorbent substance, such as a lump of horse manure, a corncob, a handful of rags, or even a clod of earth, which

[1] A large average, but made to include unoccupied holes, as it is much cheaper to put out a little extra grain than to plug the holes to find out which are occupied. Furthermore, grain scattered anywhere in the dog towns is liable to be eaten.

should be immediately dropped into the burrow, the mouth of which should then be closed.

For introducing the bisulphide there is nothing better than dry horse manure—a material which costs nothing and is always at hand. A lump of horse manure wet with the bisulphide and dropped into a hole falls at once to the bottom of the vertical part, as shown in the diagram (fig. 25, *J*), where it is very near the animals. The liquid can be used to best advantage after a rain, when the interspaces in the soil are filled with water, so that the fumes are less readily diffused into the surrounding ground. This, however, is of much less consequence in the case of prairie dogs, which are deep-burrowing animals, than in the case of pocket gophers and ground squirrels, whose burrows and tunnels, as a rule, lie much nearer the surface.

Crude bisulphide, suitable for killing prairie dogs and other burrowing animals, costs about 10 cents per pound in 50-pound carboys or drums. A dollar's worth is enough to poison 100 holes. The cost, therefore, is about 1 cent a hole. The fluid should not be introduced haphazard into the burrows of a colony, but should be used only in those which the animals have been seen to enter immediately before it is applied. In this way none is wasted on unoccupied holes.

GENERAL DIRECTIONS FOR PRAIRIE-DOG DESTRUCTION.

Poisons are of very little use except in winter and early spring, when the ordinary food of the prairie dog is scarce and difficult to obtain. At such times poisoned grain, vegetables, fruit, and bread and butter are freely eaten. In distributing the poisoned grain or other material, it is usually better to scatter it about the holes instead of putting it into the mouths of the burrows, where it gets mixed with the dirt and is trodden down by the animals and lost. An exception to this course is recommended in case of the use of pellets of grain, made by wrapping teaspoonful doses of poisoned grain in greasy tissue paper; these should be dropped into the burrows. The danger to stock is much less when the grain is scattered about the colony than when it is placed in spoonfuls at or near the openings of the burrows. In case any considerable number of animals are left after the first poisoning the ground should be gone over a second time.

It should be clearly understood that the method recommended by this Department consists in two steps, the first of which is to destroy the great bulk of the inhabitants of a colony by poisoning with strychnine, applied in winter or early spring when food is scarce; the second, to kill the remaining animals with bisulphide of carbon. In this way it is believed that colonies of any size may be wiped out at a total cost not to exceed 16 or 17 cents per acre, probably less.

Bisulphide is probably the most efficient single agent known for the destruction of prairie dogs, and can be used, of course, for the

extermination of colonies of any size, and at any time of year when the animals are active. If the killing is put off until late spring or early summer, when food is plenty, the animals are not likely to eat enough of the poisoned grain to amount to anything, and bisulphide becomes the best remedy. The only objection to its general use is its cost, which is likely to be about 1 cent per hole.

OBSTACLES AND DIFFICULTIES OF EXTERMINATION.

The chief obstacle to the extermination of prairie dogs on the plains is lack of cooperation among landowners. It is of little use to kill off the animals on ranches adjacent to large colonies in which the pests are allowed to go on multiplying. Many ranchmen who have again and again poisoned those on their own lands have finally given up in despair because of the rapid overflow from adjoining lands, new animals continually taking the places of those killed, until the expense and labor of repeated poisonings were too great to be continued. Complaints from this source are common in the case of ranches adjoining Government, State, or school lands, and railroad lands, and occasionally arise in the case of those adjoining lands owned by nonresidents, corporations, and certain individuals. This phase of the subject requires local legislation. In some States drastic measures have been recommended. Thus, in Texas, during the session of 1899, a bill was introduced making it the duty of every man owning land inhabited by prairie dogs to destroy the animals, under penalty of a fine not exceeding $100 for each section or part of a section on which the pests were allowed to remain. In the case of land owned by corporations or nonresidents, the destruction of the animals was provided for, the expense to be a lien on the land. While this bill failed to become a law, it had many supporters, and goes far to show the real extent of the prairie-dog scourge.

The Kansas legislature has recently appropriated $5,000, to be expended under the supervision of the regents of the State agricultural college, in "experiments for the purpose of determining the most effective and economical method of destroying prairie dogs and gophers," and has also authorized the township auditing boards to expend $100 [or more if requested by two-thirds of the electors of such township] in each township each year for the destruction of these animals (approved February 12, 1901).

PRAIRIE DOGS ON NANTUCKET.

In 1890–1892, one or two pairs of prairie dogs were introduced into Nantucket, where, for several years, they increased slowly and were regarded with interest. After a few years, however, they grew so numerous and spread so rapidly that the inhabitants became greatly

alarmed and feared the animals would overrun the whole island. Mr. Outram Bangs wrote in December, 1899, that when on a visit to the island during the summer and fall of the same year he counted 200 prairie dogs visible at one time in one colony, and states that three or four such colonies existed, besides many scattering pairs and small colonies. A specimen sent the Biological Survey by Mr. Bangs proves to be the plains species (*Cynomys ludovicianus*), in rather red pelage, and probably came from some point on the Great Plains between western Kansas and Texas.

W. W. Neifert, writing from Nantucket, under date of February 12, 1900, states that ten years previously two pairs of prairie dogs were brought to the island, where they multiplied so rapidly "that they are now counted by thousands, and are a dangerous pest and nuisance, destroying crops and fields;" also, that "at a recent town meeting a committee was appointed with a view of exterminating them and an appropriation of $350 was made to procure poison." In a subsequent letter, Mr. Neifert writes: "In addition to the $350 raised by the town, about $200 was subscribed by farmers and others interested. The poisoning scheme was adopted, and bisulphide of carbon was the drug. A bunch of old rags was saturated and placed in the mouth of the burrow and the hole closed with dirt or sod. This method was simple and inexpensive but did the work successfully, and now there is not a dog left to tell the tale."

MOHAIR AND MOHAIR MANUFACTURES.

By George Fayette Thompson,
Editorial Clerk, Bureau of Animal Industry.

PURPOSE OF THIS ARTICLE.

The purpose of this article is twofold: (1) To call the attention of the breeders of Angora goats to the weak points of their animals as mohair producers, with suggestions as to measures for improvement, and (2) to call the attention of people generally to the great beauty, durability, and comparative cheapness of mohair manufactures, with the view of encouraging a stable and more extensive use of these goods.

FLEECE OF THE ANGORA GOAT.

Mohair is the technical name for the fleece of the Angora goat. It differs from the wool of the sheep in that it does not have the felting properties of the latter. The felting property of wool is due to the presence of scales, or epithelia, which cover the fiber in much the same manner that scales cover fish. It is the felting property of wool which distinguishes it principally from other animal fibers. Mohair is a hair próper, being devoid of scales, and so is not successfully used alone in felt goods.

The fleece upon the goat is pure white, is exceedingly lustrous, and grows to an average length of 10 inches annually. It hangs in beautiful wavy curls, or ringlets, from all parts of the body, if the animal is of the best breeding. The average annual production per head of mohair is about 4 pounds. The grade of the goat has much to do with the weight of the fleece. The first cross of an Angora buck upon a common doe gives but a small amount of mohair, but the increase in quantity is notable as the crosses become higher. (Fig. 26.)

In Turkey, in South Africa, and in most States of the Union, shearing is done annually, as with sheep; but in the southwestern part of the United States, where probably the greater number of the flocks are located, the goats are sheared twice a year. This practice is due principally to the long warm season, which causes the goats to shed if they are not sheared; but feeding and careful handling will do much to prevent shedding, even though the warm season may be severe and long. It is not infrequent that goats are found in the Southwest carrying an annual fleece, and occasionally there is one having a fleece of eighteen months' to two years' growth. The great mass of them, however, will drop the fleece if it is not sheared semiannually. Of course,

these semiannual clips are much shorter in length than the annual clips, and therefore are not so valuable in the market. While the semiannual clips together average a little heavier than the annual clip, the difference is not sufficient to compensate for the added care and expense of shearing and the reduced price.

As just intimated by reference to the length of the clip, it is quality that gives to mohair its relative value. The manufacturers desire a long fiber, very fine, and strong. While there are uses for coarse grades of good length, the price is not so large as for the finer grades.

FIG. 26.—Imported Angora goats. (Photograph furnished by W. M. Landrum.)

The finer fleeces are produced by kids, wethers, and the younger does. The fleece of all Angoras grows coarse after the goats are six years old, beginning even earlier than this with bucks. The finer grades of mohair are used principally in the manufacture of plushes and the coarser grades in dress goods, coat linings, etc. Feeding has much to do with the length and strength of mohair as well as with the weight of the fleece. The colder climates also increase the fineness and add to the weight.

The table following, which is compiled from a "Report of examination of wools," etc., by Dr. William McMurtrie, and published by

the Department of Agriculture in 1886, gives a very interesting comparison between length, fineness, strain, and stretch of mohair and commercial grades of wool:

A comparison of mohair and wool fibers.

Description.	Length.	Fineness.		Strain.		Stretch.	
	Inches.	*Centi-millime-ters.*	*Thous-andths of inch.*	*Grams.*	*Grains.*	*Millime-ters.*	*Per cent.*
Mohair (average of 480 tests) ...	6.91	3.157	1.2429	19.12	295.11	10.60	26.50
Commercial wools (average of 1,410 tests)	2.62	2.118	.8352	7.01	108.79	5.02	25.11

It will be observed that mohair is not equal to wool in fineness, but in strain there is a difference much greater than would be suggested by the larger fiber. The average wool fiber in these tests stood a strain of 108.79 grains, while the average mohair fiber stood a strain of 295.11 grains. This is a difference of 186.32 grains—much more than double the strength of wool. It is to this strength of fiber that the great durability of mohair goods is ascribed. In stretching quality there is but a slight difference between mohair and wool. Dr. McMurtrie makes the point in discussing wools that the individual fibers may be variable in size, a condition brought about, it is supposed, by sudden changes in weather or feed, or by ill health. Dr. McMurtrie's remarks on this question are applicable to mohair, and so are copied here somewhat extensively:

In the study of the wools constituting the collection under present examination, one can not avoid being struck with the lack of what the German authorities term *Evenness Treue*, or uniformity in the diameter of the fiber throughout its length; and this property is probably one of the most important, if it does not even stand first, in the determination of the commercial and industrial value of the staple. It is the result of two causes—the one atrophy of the fiber at certain parts, the other hypertrophy. In other words, when we examine a sample of uneven staple with the microscope, we notice a greater width of the images at some parts than at others, and these variations are by no means wanting in interest, nor are they absent in many of the animals said to have received excellent care and feed. In some cases we find a sudden contraction of the fiber at certain points (atrophy), and this is often sufficient to give the edge of the image a decidedly notched appearance. In other cases the contraction is more gradual, the progressive diminution of the width of the image extending over a greater length of the fiber. In the enlargement, however (hypertrophy), such sharp variations do not obtain; the fiber begins to enlarge at a certain point, and the enlargement may continue through the length of the fiber until it attains a diameter even twice as great as at other parts. * * *

Where atrophies occur the fiber must necessarily be weakened, while, on the other hand, staples in which the atrophied fibers occur in any important proportion must interfere with the regular passage of the material through the several machines and processes of the factory. In both cases, therefore, they seriously impair the value of the products, and it behooves growers to look to the causes which may have a tendency to bring them out. What these causes may be we have had no opportunity

to determine, but there can be little doubt that bad nutrition, exposure, and consequent impaired health or constitution are the more prominent. A fevered condition of the system probably tends to check normal exercises of the functions of the skin, and hence the growth of the fiber resulting in atrophy, or it may have the contrary effect and cause hypertrophy. * * * We have sufficient evidence to show that when animals have been well fed and cared for, and when the health of the animal has been uniform, such deformities in the fibers do not exist. And that the growth of the wool is retarded, or at least that the diameter of the fiber is diminished by impaired health of the animal is well illustrated in the following bit of our own experience. On one occasion a prominent breeder of Merino sheep submitted a sample of his wool for the determination of its fineness. By the system of measurement followed we found that the fibers were finer at a certain part or point in their development than at others, and by simple calculation it was easy to determine at what part of the season the finer portion of the staple had developed. We stated that at that season the animal must have been in ill health, and this was afterwards confirmed by reference to the record of the condition of the different individuals of the flock during the year. And it further illustrates the importance of great care in the management of sheep and the value of protecting them from any sudden changes, and from the inclemencies of the weather in general.

All mohair has a luster peculiarly its own, but this is much more pronounced in some fleeces than in others. That having the higher luster, other qualities being equal, commands the better price. A fleece of low luster indicates a goat under influence of adverse conditions, as poor breeding, poor feeding, or sickness. The uninformed often express the opinion that this luster is due to oil in the fleece, but this is erroneous. Whatever oil there may be in mohair is inside the individual hairs, and not on the outside, as in the case of wool. A mohair fleece may be washed, then scoured, and then steamed, dyed, and worked up into fabrics after reaching the mills, but none of these processes removes any of the luster; indeed, all of them operate simply to intensify it.

PRESENCE OF KEMP IN MOHAIR.

It is a fact well known to breeders that the Angora goat has two coats of hair. The outer and more abundant coat is the mohair, while the under coat is a coarse, chalky white, straight, stiff hair, varying in length from one-half to 4 inches. This under hair is known by the name of kemp. It is generally believed to be the relic of the common goat blood in the Angora, for it is a matter of history that the Angora flocks of the United States, as well as those of Asia Minor and South Africa, have been largely increased by crossing upon the does of common blood. This has been done to such an extent, indeed, that it is no longer contended that there remain any Angora goats of absolutely pure blood. This disbelief in pure blood is based upon the fact that the first cross of an Angora upon a common doe yields a fleece in which kemp largely predominates, and that as the crosses become higher the quantity of kemp grows less. That point has not yet been reached, however, where it can be said that a strain has been produced

which has no kemp whatever, although a few breeders in this country and in South Africa appear to have very nearly reached that very desirable result. This is the principal end to which breeders should lend their best efforts at this time. It is the most difficult quality to obtain. Length, strength, fineness, and luster may all respond readily to the intelligence of the breeder, but kemp is stubborn. The hope is confidently expressed by the best breeders that a strain of Angora goats will yet be produced which will be entirely free from kemp.

The spirit of the goat men who met in Kansas City on October 24–28, 1901, in attendance upon the meetings of the American Angora Goat Breeders' Association, showed that they were not only willing but anxious to undertake the solution of this problem. While all these men were familiar with kemp and knew that it was a deleterious feature of mohair, not many of them knew before this meeting was held how objectionable it really is to the manufacturer, and consequently how much it tends toward keeping the price of mohair low.

At Kansas City the mohair producer and the mohair manufacturer met each other for the first time in this country, the presence of both being in the interests of the Angora goat industry. George G. Emery, of Sanford, Me., addressed the association on three occasions during the week, his theme each time bearing upon the quality of fiber required by the manufacturer. He displayed a large assortment of goods, using them to supplement his argument concerning the uses and value of good mohair as compared with the poorer grades. The writer of this article, representing the Bureau of Animal Industry, also addressed the association along the same lines. The goat men showed a disposition to learn all that is required by the manufacturers, and determined to redouble their efforts toward a higher standard for their flocks. The large price of $1,050 was paid for the buck Columbia Pasha at the Kansas City goat show, principally because of his freedom from kemp. It is true that his fleece was fine and long and his body was fully covered, but the appearance of the animal as he stood in the pen (his size and carriage), although he was a "good looker," had comparatively little weight with the judges, who gave to him the sweepstakes prize as the best buck of all ages in the show.

WHY KEMP IS OBJECTIONABLE.

The reason why kemp is objectionable is that it will not take the dyes used for mohair; the only effect of the dyes is slightly to discolor the kemp. There are dyes, it is true, which act upon kemp, but they have no effect upon mohair; and the best efforts put forth have not yet resulted in a mixture of dyes that will act satisfactorily upon both mohair and kemp at the same time. The only solution, therefore, is to remove kemp from fleeces which enter into the manufacture of fabrics in which it is undesirable.

Kemp appears in its worst phase in plushes, where every individual hair shows prominently. Its presence here is much more pronounced than when in the fleece, where it is nearly of the same color as the mohair. It is therefore of great importance that this objectionable substance should be removed from the fleeces. If any kemp should escape the eye and be woven into the plush fabric it would not be discovered until the fabric came from the dye; for it must be remembered that mohair plushes are woven "in the white," and afterwards (perhaps several months or a year) are dyed according to instructions to fill orders. Kemp, at this stage of the process, becomes an expensive proposition, for skillful hands must burl out every fiber of it as well as every other bit of foreign substance. In the cheaper plushes, such as are largely used in street cars, there is a considerable quantity of kemp. Much of this material may also be used without detriment in the manufacture of rugs.

The problem of the mohair manufacturer is the same as that of the mohair grower—how to get rid of kemp; and the burden of his meditations is to devise some sort of machinery that will do the work perfectly. American ingenuity has so far failed to invent such a machine; and so the manufacturer finds it necessary to call upon the breeder to produce mohair without kemp. The solution of the problem, therefore, appears to be with the breeder rather than the manufacturer.

But the fact remains that the mills must get rid of kemp in some way, and the device which they use for the purpose is a machine which combs it out; but while the comb is removing the kemp it removes at the same time every mohair fiber of equal length with the kemp. This means that if the mohair going into this comb has kemp 3 inches long all mohair fibers up to 3 inches in length must go out with it. The result is heavy loss. True, there is a use for this mixture of kemp and short mohair, as heretofore stated, in the manufacture of cheap goods, such as horse blankets and filling for carpets, and also for stuffing saddles, and it has a value ranging from 7 to probably 10 cents per pound. From the breeders' standpoint this residue from the combs will be considered as a loss, and he must figure it as wastage. This wastage runs from 5 to 40 per cent. It is eminently proper to quote here the opinion of one who has spent many years in fabricating mohair, namely, George B. Goodall, of Sanford, Me.:

> A majority of the mohair growers in this country little realize how much kemp has to do in keeping down values of their clips. If they could spend a few hours in our sorting and combing rooms, the lesson learned would be of great value to them—more than could be obtained by reading. In watching the combs at work they would notice some making 5, 10, or 12 per cent of noil or waste, while others will be taking out 30 or 40 per cent. Ask the comber the reason of this, and he will reply that one lot has a much larger amount of kemp than the other. One fiber of kemp takes out five or six good fibers which should go into yarn.

The thought has probably already occurred to the breeder that the longer the kemp the greater the wastage. But how can kemp be shortened? is the question of importance next to getting rid of it altogether. It is generally accepted as a fact that long kemp is evidence that the animal producing it is bred up from long-haired Mexican does, while short kemp is a relic of short-haired does, such as are quite common in suburbs of large cities. If this be true, the point is already made that, in building up a flock from common does as the foundation, none but short-haired ones should be used.

Let it be said in passing, however, that there are so many thoroughbred and high-grade Angoras in this country now that the reason or necessity for crossing upon common goats does not exist as it did several years ago. To continue the practice is to continue the injection of kemp into Angora blood. The crossing upon common stock has been done with the double purpose in view of increasing the flocks more rapidly and of infusing stronger blood into the Angoras. As stated above, the necessity for the first is probably past; with regard to the second, it can be said that there are now in the country strains of Angoras which are as large and vigorous as any common goats may be. These might be used to impart constitution to the delicate flocks.

Finally, concerning kemp, its presence in mohair is not objectionable on the score of durability, for it has lasting properties, but its coarseness and its inability to take mohair dyes make it undesirable.

DURABILITY OF MOHAIR.

The durability of mohair and mohair manufactures is well known to those who are familiar with their use. Statements which to some may seem incredible are on record, but there is no good reason to doubt their accuracy. S. Holmes Pegler, author of the excellent English work, "The book of the goat," states that in 1881 the Duke of Wellington imported a half dozen Angoras from the Cape, and many of the clothes worn by the duke were from the fleeces of these goats, and he continues: "I myself possess an overcoat cut from the same stuff, presented to me by his Grace, which promises to be everlasting as regards wear." Dr. James B. Davis, who first introduced Angoras into the United States, having himself brought them from Asia Minor, says in an article which he published in the Annual Report of this Department for 1853: "I have socks which I have worn for six years and are yet perfectly sound." A friend of the writer states that he has had one mohair rug at his office door for twelve years, and it does not yet show much wear, while the luster and color remain as distinct as when new. Ladies who have worn mohair crepons and brilliantines are all aware of the wonderful durability of this fiber.

Strange as it may appear upon first thought, it is the durability of

mohair dress goods that has prevented their more extensive use heretofore. The first cost being somewhat high, they have not generally been worn by people whose principal aim is durability in the purchase of clothing. They have been subject to the caprices of fashion, being "all the style" one year and "out of style" the next. This has naturally restricted their use largely to that class of people who could afford to discard them before wearing them out.

Even though the first cost of these goods may be high, their use would prove economical for that class of people who desire good quality and good appearance without affecting the highest degree of fashion. They will preserve their color to the last and the luster will never disappear.

INFLUENCE OF FOOD AND CARE OF GOATS ON FIBER.

Any wool grower knows that feed and care have a very great influence upon the weight and fineness of the fleece. The same is applicable to mohair growing as well. If goats are exposed to sudden changes of weather the effect is shown in the fleece. Under adverse conditions an individual mohair will show contractions, which greatly reduce its "stretch" and "strain." This point is fully covered in the quotation from Dr. William McMurtrie, on page 273, and need not be further mentioned here.

John S. Harris, one of the early breeders of Angora goats, and who is a man of good observation and rare judgment, says that the finest and evenest mohair is from goats which feed upon grass. He says that brush is "pie" to goats, and a little pie will do no harm; but all pie is not good. While this is contrary to the opinion of most breeders, the experience of one who has so long been raising goats should not be hastily cast aside.

S. C. Cronwright Schreiner says:

> If goats are to produce the best fleeces they are capable of they must be maintained in uninterrupted good condition. They must have a variety of food, principally shrubs and aromatic plants, and lead an active life; they must, if possible, have running water to drink, and be kept free from dust; they must not be kraaled (or shedded) except when absolutely necessary; they must have clean sleeping places, and must not be crowded together.

It is the opinion of the writer that the many important points concerning the length, strength, and fineness of fleeces should be the subject of scientific experimentation, which experimentation should include the effects of feed and climate. The results of an investigation of this character would answer as well for the sheep industry of our country, with its annual wool production of 289,000,000 pounds, as for the growing mohair industry; for the same conditions govern with both fibers.

PRICES OF MOHAIR.

A long chapter might be written about the reputed prices obtained for mohair during the first few years after the introduction of Angora goats into this country; but as there were no mills in this country at that time which were able to fabricate the fleeces, and as the quantity of mohair produced was very limited and of uncertain quality, and as there appears to be no definite data available of sales made at the enormous prices which are sometimes referred to, it would seem that no useful purpose will be subserved by discussing the prices of that period. Attention will be given, therefore, to the prices of the present, for these are the prices which interest the mohair growers of to-day.

What has been said in previous paragraphs about varying qualities of mohair has no doubt suggested the thought that prices also are very variable, which is true. It is not the quality alone which affects the price, but supply and demand, which affect all articles of commerce, play a very important part. It was decreed by Dame Fashion last year, for instance, that mohair dress goods were not in style, and the effect of this decree was to reduce the value of mohair. Other causes, a principal one of which was a very limited demand for car plush, also contributed to the cause of low prices.

To give a brief answer to the question, What is mohair worth? is not possible. There are more grades of mohair than there are of wool, and there has so far been no effort on the part of mohair producers to so sort their fleeces as to enable them to receive the highest price for each class, but they have been content to sell it in one mixed lot. This always tends to reduce the price below its real worth, because the purchaser, not knowing exactly what he is buying, protects himself with a low price. The features that make for low prices are shortness and coarseness of fiber, and the presence of kemp, burs, and dirt of all kinds. There were on exhibition at the Kansas City show some fleeces which looked as if they might have been raked out of a filthy hogpen; these had been sold at 7 cents per pound, while other fleeces in the same exhibit were worth 40 cents per pound.

Probably the average price paid for mohair during the past season was about 25 cents per pound. The product of the lower crosses, which contains a large percentage of kemp, brings a low price (10 to 15 cents), while there were some fleeces that brought 40 cents. There is not a large quantity of this latter quality of hair produced in this country, for the reason that the breeders have not given the matter proper attention. There is a great demand for the better hair, while the lower grades, which enter into the manufacture of carpets and horse blankets, find direct competition in wool.

While on the subject of prices, we will quote from a recent address by George G. Emery, of Sanford, Me.:

I have read where prices as high as 45 cents per pound have been paid this season for domestic mohair. Now, such statements should be followed by an explanation, otherwise false hopes are apt to be raised in the minds of the growers, which hopes, in my opinion, are not to be realized. I can take any bale from among the hundreds sent us yearly from the State of Oregon (and the same applies to the twelve months' growth Texas hair; in fact, in any State producing mohair to-day), and I can find mohair which is worth 45 cents per pound and even more, but the percentage of the low grades, worth from 18 cents to 20 cents, is so much greater and so far overbalances the fine as to bring the value as a lot to a much lower figure. I have seen some very choice domestic mohair, but the amount of such hair is very small when compared with the total production of the country.

Prices in the Cape of Good Hope have ranged about the same as in our own country.

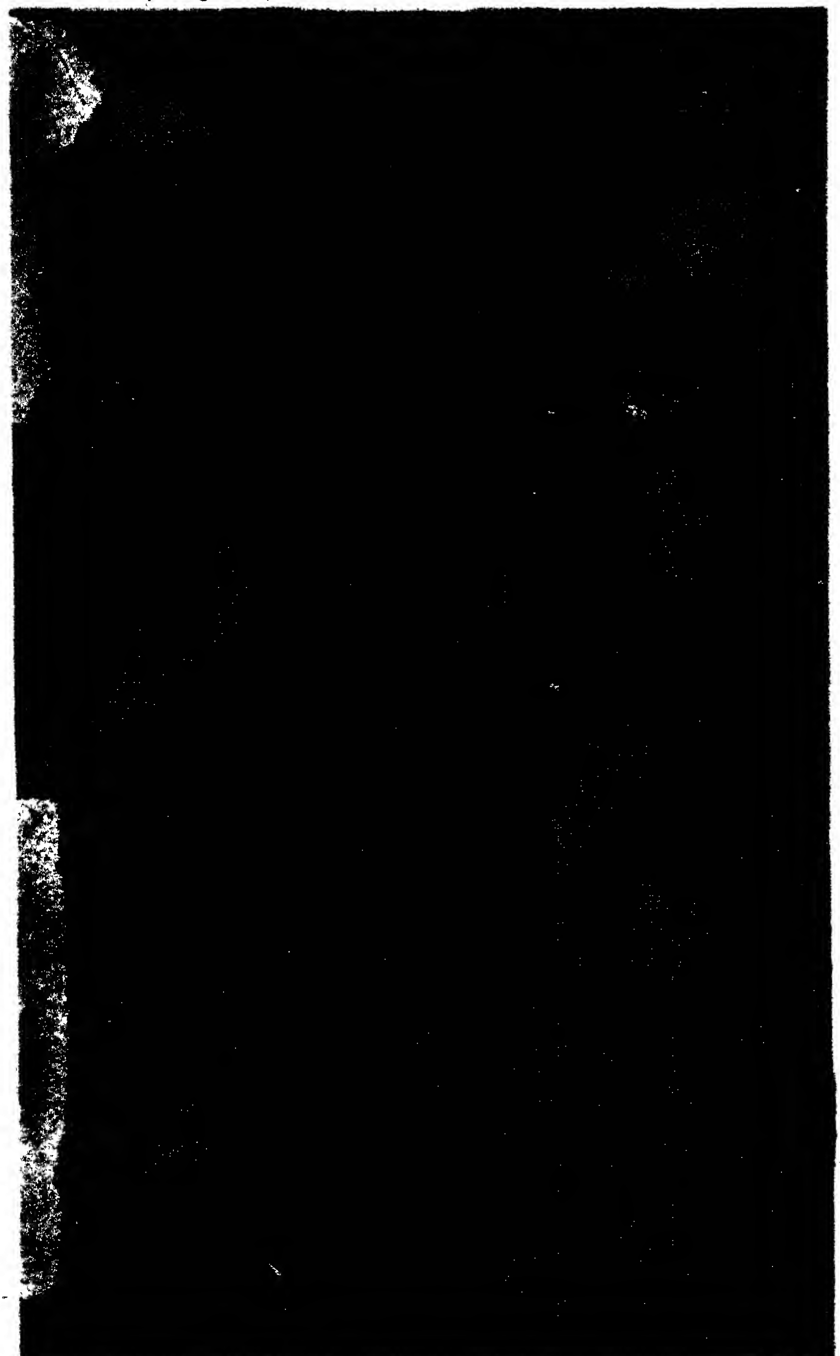
The great mohair manufacturing center of the world is Bradford, England, and as it will be interesting to many to see the prices which mohair has brought in that city during a long series of years, the following table is prepared from data compiled from the Bradford Observer by the National Association of Wool Manufacturers:

Range of prices of mohair at Bradford, England, from 1856 to 1894.

	Cents.		Cents.		Cents.
1856	48 to 56	1869	86 to 88	1882	38 to 45
1857	56 to 66	1870	92 to 98	1883	40 to 43
1858	60 to 72	1871	78 to 84	1884	37 to 45
1859	72	1872	82 to 90	1885	28 to 36
1860	76	1873	72 to 80	1886	23 to 32
1861	76	1874	70 to 90	1887	25 to 29
1862	72 to 78	1875	82 to 92	1888	24 to 28
1863	80 to 88	1876	86	1889	25 to 42
1864	78	1877	60 to 70	1890	27 to 36
1865	70	1878	60 to 66	1891	24 to 28
1866	80	1879	36 to 54	1892	24 to 29
1867	66 to 90	1880	42 to 54	1893	24 to 37
1868	58 to 76	1881	38 to 42	1894	27 to 31

But what of prices in the future? This is the important question with the breeder, and it is one that is difficult to answer. It seems likely that there will be an increasing demand for mohair in the classes of goods which now consume it, to say nothing of the new uses that may be developed; hence it may be expected that the demand will be strong. On the other hand, there will doubtless be an increased production, which will have a tendency to lower the price. There are so many uses for mohair already established in the world that it is not believed that prices will ever fall to a level with wool. One prominent manufacturer of mohair goods expresses the opinion that the "average prices paid this year [1901] can be considered as a low-water mark." This was about 25 cents a pound, as stated above.

The American Wool and Cotton Reporter states that with an



JULIUS BIEN & CO. N.Y.

HAND-PAINTED MOHAIR PLUSH.

increased production of Angora goats in this country, and the consequent enlarged production of mohair, the latter is going to be consumed more largely than heretofore, and is, indeed, already "cutting more of a figure in the wool market." The domestic product is favored by a tariff of 12 cents per pound on the imported article.

CARING FOR FLEECES.

It may not be known to goat breeders generally that the objection to any foreign fibers in mohair is the same as that which holds against kemp, namely, they will not take the mohair dyes. Therefore, if every particle of such foreign substance is not removed before going into the fabric, it shows in a prominent and unpleasant manner when the article is dyed, and necessarily cheapens it if it can not be burled out. For this reason mention is made here of the practice, quite general in this country, of tying fleeces with twine. In removing this twine at the mills it is almost impossible to prevent portions of it from adhering to the fleece, and it must be removed so far as possible by the most painstaking care. Fleeces from Turkey and Cape Colony are not tied, but simply rolled up inside out, and this is the condition in which the mills desire to receive them.

Goats should be washed before shearing, in the manner that sheep are washed, for much dirt will thus be removed, and the value of the fleece greatly enhanced. After the fleece is taken from the goat, it should be spread out upon a clean table, where all foreign substances may be carefully removed. While this procedure is tedious, and to some may appear useless, it will pay; for the work must be done on the farm or at the mill, and farm labor is not so expensive as mill labor.

MOHAIR MANUFACTURES.

The first striking feature of mohair manufactures is their great beauty. The luster of the hair, which is so pronounced even while it grows upon the goat, remains in the manufactured goods, and no amount of washing and no character of dye will remove it. It aids the dyes to show their colors more effectively, and imparts to the goods the pleasing property of changing shades in shifting lights, which is a feature quite characteristic of silk goods.

A second feature of importance is that the dyes are usually fast, and however much such goods may be exposed to the elements they will not fade. In the best mills fugitive dyes are not used except when an order is received to match a sample which has been treated with such dyes; for a fugitive dye can not be matched by a fast one, nor can a fast dye serve for a fugitive one.

The durability of mohair goods has been quite fully discussed in connection with the durability of the fiber composing them. It is a characteristic that ought to make their use economical in many ways.

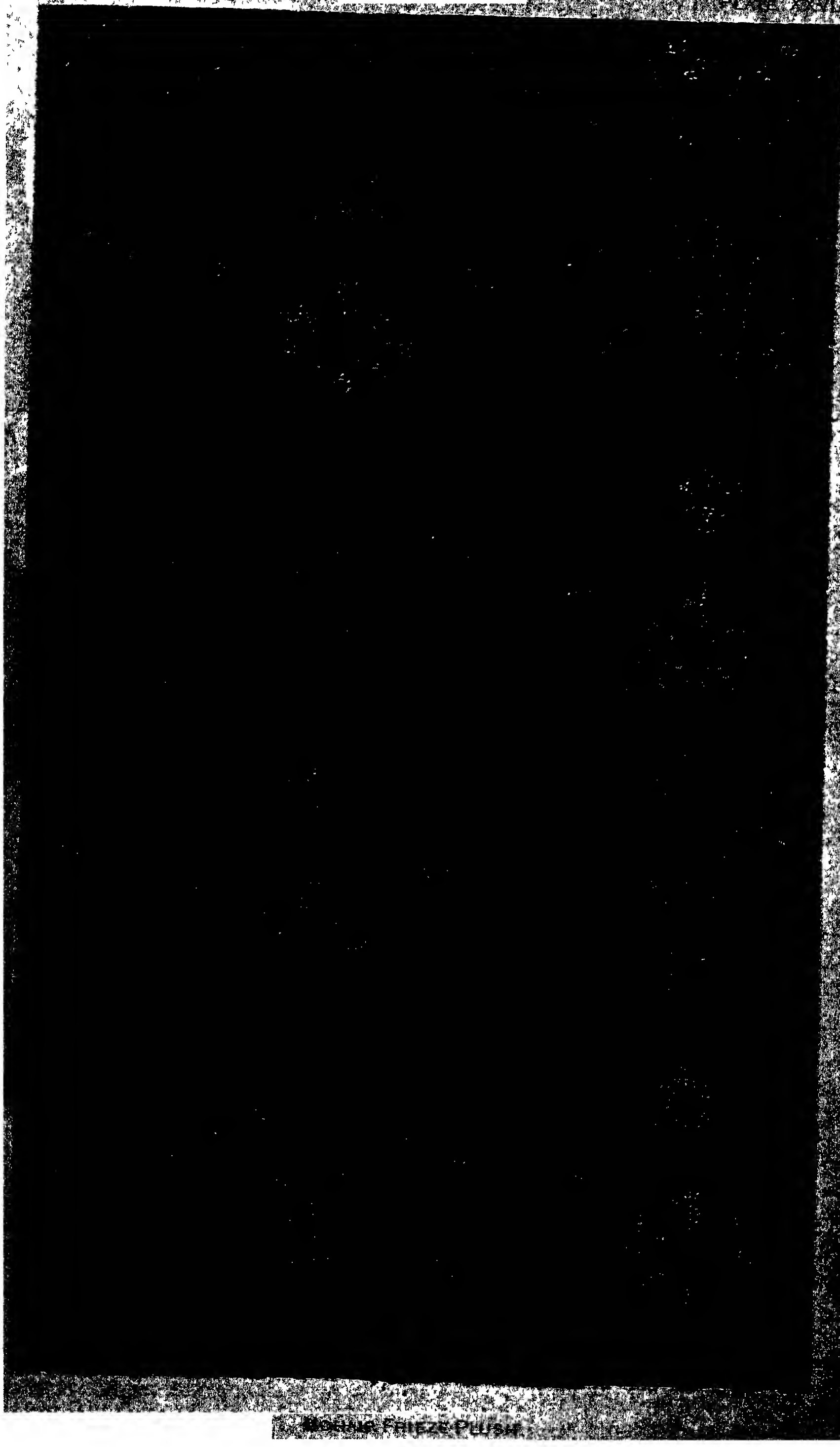
This should be the case especially with dress goods and other wearing apparel.

Mohair manufactures already have a very extensive use, but they appear in the stores under so many trade names that only a few people, comparatively, know that they are the product of the Angora fleece. These manufactures are so varied, and the fiber adapted to so many things which are now made of wool or cotton, that no attempt will be made here to give a complete list of them, but a recital of some of the principal uses of mohair goods will be made, in order that it may become generally known how extensive is their use at the present time, and some idea formed of the possibility of extending the use of mohair to other lines of manufacture.

By far the most important product of mohair manufacture is plushes. It is a fact not generally known that practically all of the plushes used in railroad passenger cars are made of mohair; so also are the plushes used in street cars. How much is used annually in the passenger cars of our country can only be conjectured. The report of the Interstate Commerce Commission for the fiscal year of 1899 shows that there was an increase of 244 cars over the previous year; let us add to this a number to take the place of those worn out, which probably can not be less than 200, thus giving a total of 444 new passenger coaches each year. Each coach requires at least 120 yards of plush, and the total quantity required for the 444 cars would be 53,280 yards. This is an underestimate rather than an overestimate. During the year mentioned there were in service in the United States 16,785 first-class passenger cars, 3,063 second-class cars, 4,206 combination cars, 464 parlor cars, and 488 sleeping cars—total 25,006. This means that there were in use that year 3,000,720 yards of plush. Add to this all that is used in street cars, omnibuses, etc., for which there is no basis for an estimate, and we may conclude that its use for such purposes is enormous.

Besides the car plushes, which are usually plain, large quantities of frieze and crush plushes are used in upholstering furniture. The designs for the frieze plushes are limited only by the ingenuity of man. The skill of the fabricator is so well developed that the threads forming the designs are in loops and of different color, yet the whole is woven at one time "in the white" and afterwards colored in the same dye. The crush plushes are very handsome, showing to best advantage the effects of varying lights upon solid colors. This kind is largely utilized in upholstering armchairs, but finds large use also in other kinds of furniture. (Pls. XXV and XXVI.)

The carriage robes, couch covers, sofa-pillow covers, and rugs are distinguished by their high pile and rich coloring. The pile upon the carriage robes and sofa-pillow covers is about half an inch high. The robes sometimes have the pile on one side only, but many are made



Mohair Frieze Plush.

with the pile on both sides. The coloring is most exquisite, as is true of the sofa-pillow covers and couch covers. These colors are printed on by hand after the pieces are woven, and are rendered indelible by long steaming. Rugs necessarily require more modest covering, but all the richness of subdued colors and luster remain to make them a distinctly beautiful as well as useful ornament. These goods have not long been upon the market, but they can hardly fail to attract attention and advance in favor.

Most of the so-called astrakhan now in use so extensively is made of mohair. It has all the beauty of the real article, is much more durable, will never change its shade in sunlight or air, and is in no manner inferior to real astrakhan.

This Bureau has been furnished with samples of plain mohair dress goods (brilliantines), as well as mohair crepons, which are common and well known for their durability. There is no other kind of cloth which is more easily cleaned or which retains its newness for a longer period. For this reason brilliantines are especially popular for traveling dresses. Mohair crepons are more beautiful, but also more expensive, costing from $1.25 to $5 a yard. The cheaper grades are woven upon a cotton base, and go to pieces sooner than when woven upon a wool base. In crepons there is sometimes an admixture of silk.

It would be very difficult to enumerate the many ways that mohair might be used in manufactures. Besides plushes, which form the principal item, there may be mentioned dress goods of various designs, coats and coat linings, table covers, knit mitts, mittens, gloves, etc., which are already on the market. It has been found that mohair cloth is the only kind that will stand the strain in the expressment of cotton-seed oil, and there is a growing demand for it for this purpose. A suggestion has recently been made that mohair could be manufactured into tent and sail cloth and rain coats, having as its qualifications durability, lightness in weight, and immunity from molding. Mohair cloth will not only turn water, but will hold water like a skin if the water is not beaten through it. A piece of brilliantine in the form of a bag and holding a glass full of water hung all day in this office and not a drop passed through it during that time. Mr. John S. Harris recently informed the writer that he possessed mohair cloth 40 years of age which would hold water in the same manner. Tent and sail cloths would necessarily be heavier, and be even more effective in turning water. It is argued that the extra cost of this kind of cloth for these purposes is more than compensated for in the matter of durability and lightness of weight.

SKINS OF ANGORA GOATS.

Ordinarily, one would not expect to find a discussion of Angora goat-skins under the general subject of mohair manufactures, but in consideration of many of the special uses to which the skins are put, because

of the mohair rather than the skin to which it is attached, it seems proper to discuss the matter here.

The skins of the Angoras, if taken when the hair is about 4 inches long, make very handsome rugs. The hair retains its original luster, and may be used in the natural white or dyed any color desired. The pure white ones are more generally preferred. There is a demand for Angora rugs in the United States which so far has not been supplied by domestic production. These rugs can be purchased at prices ranging from \$4 to \$8.

Another article of manufacture from the skins is the carriage robe, rivaling in beauty and durability the buffalo robe, which is no longer a factor in the market. They are not expensive when the demand for skins is considered, and may be purchased for about \$20. The smaller skins of the does and wethers and the kid skins find an extensive use in baby carriages, and are exceedingly attractive in their brilliant white.

These skins are used largely in the manufacture of children's muffs and as trimmings for coats and capes. The finest kid fleeces adorn the collar and border of some of the ladies' most handsome opera cloaks. In the stores they are sold often under some peculiar name which does not inform the purchaser that they are ornamented with the hair of the Angora goat, and so thousands of such articles are worn by people who are unaware of the true name of their "furs."

There is a tariff of 12 cents a pound on mohair and a varying schedule applying to mohair goods, but skins having fleeces attached come in duty free. Importations are without doubt very large, but it is impossible to give the figures, as the Treasury Department does not keep the records of imports of Angora skins separate from skins of other goats. Our source of supply for these imports is Cape Colony.

THE COTTON-SEED INDUSTRY.

By Charles M. Daugherty,
Of the Division of Statistics.

INTRODUCTION.

Of the ordinary commercial fiber plants, cotton is the only one the fiber, or lint, of which adheres to the seed; the fiber of the others is derived from the stalk, or stem. From the cotton plant both seed and fiber are gathered by a single operation, so familiar to the colored people of the South as "cotton picking;" but from the other fiber plants the fiber is separated by such processes as retting and scutching, entirely distinct from that of harvesting the seed of such plants as flax, hemp, etc. From this characteristic of the cotton plant, necessitating the handling of the seed in order to obtain the lint, there have been evolved, through a slow and unforeseen course of events, two separate industries of vast economic importance. The invention of the cotton gin over a century ago had for its sole purpose the separation of the valuable lint from the then worthless seed. The marvelous effect of this invention upon cotton production and industry throughout the entire world, but especially in the United States, forms one of the most interesting chapters in the annals of agriculture. For three-quarters of a century thereafter (a period, too, characterized by an ever-increasing utilization of the forces of nature) cotton was raised over larger and larger areas almost exclusively for the lint, and the cotton seed remained by all odds the most important contribution of the Southern States to the world's great volume of waste.

GROWTH OF THE COTTON-SEED INDUSTRY.

It was not until after emancipation—not, indeed, until after the cessation of the disturbed political and economic conditions of the reconstruction period in the South—that the seed of cotton was utilized to any important extent for industrial purposes. True, there is record of a mill for the extraction of oil from cotton seed at Columbia, S. C., as early as 1826; another was built at Natchez, Miss., in 1834; one is known to have been in operation in New Orleans in 1847; and a few other mills were built previous to the civil war. But as late as 1867 the slow progress that the industry had made was attested by the fact that there were only four mills actually in operation in the United States. The early operations of the new industry were carried on

with the greatest secrecy, as though to guard a valuable mechanical secret, but it is now known that no radically new mechanism had been invented, as had been the case in separating the lint, for the extraction of oil from cotton seed. In the main, the machinery and principles long utilized in different parts of the world for the extraction of linseed oil from flaxseed had merely been adapted to new uses.

The cotton-seed industry, at present one of the most important industries of the Southern States, has, therefore, been practically the growth of the past thirty-odd years. It is confined, so far as the United States is concerned, exclusively to the cotton-producing States. The liability of the seed to heat or to deteriorate, if either moist or sappy, in transportation or in storage, has had a tendency to confine the erection of mills strictly within the territory where the raw material is grown; and the South has to-day a more exclusive monopoly of the manufacture of this product than of any other product of agriculture raised generally throughout that section. From 1867 to 1897, a period memorable for the awakening of industrial activity and enterprise throughout this theretofore strictly agricultural territory, some 300 cotton-seed oil mills were erected throughout the South. About one-third of these were built in Texas, a State where not far from a like proportion of the cotton crop is now annually grown. The remainder were distributed throughout all the other cotton-producing States, the guiding purpose in construction usually being, not to embrace the apparently inexhaustible sources of supply, but rather to secure the easiest delivery of seed, either by wagon, rail, or boat, at individual mills. Among the many cities, towns, and villages that profited from the establishment of the new industry, Memphis, Tenn., because of terminal, transportation, and other facilities, became prominent as the largest single cotton-seed oil producing center in the United States, and, with one exception, in the world. The 300 mills erected throughout the South during these thirty years were generally in response to a steady increase in the variety of uses made of their products. No effort was made to create a milling capacity capable of handling more than a small, though constantly increasing, proportion of the annual supply of raw material. In fact, at the close of this period it is estimated that only about 40 per cent of the total cotton-seed crop was utilized for manufacturing purposes; the remainder, save that used for seeding and feeding purposes and the modicum used for fertilizing, was consigned to waste.

USES OF COTTON-SEED OIL.

The rapid growth of the industry was largely due to the great variety of uses, both edible and industrial, to which its products were found to be adapted. Cotton-seed oil, like many another product of intrinsic edible value, was first offered in a finished state to consumers under a

deceptive label, bearing, in this instance, the inscription "pure olive oil." Its first introduction into trade and commerce was as an adulterant; and, as is usually the case with adulterants, its own title to consideration as a product of inherent comestible value thereby became considerably impaired in the popular esteem. The exact extent to which cotton-seed oil has since been used for mixing with olive oil can not be ascertained, but it is notable that when used for this purpose alone fancy prices attested its value, and attractive profits for manufacturers were a powerful impulse to increase in milling capacity and in production. Naturally, a decline in values followed, and cheaper high grade cotton-seed oil, mixed with certain beef products, was found to make a profitable and valuable cooking material. A product generally known as "compound lard," in which the identity of cotton-seed oil was but faintly suggested in the word "compound," was placed upon the market as a substitute for hog lard. Later, other like mixtures of cotton-seed oil with animal fats were devised, some containing pure lard, others not, and the principal market for this oil soon became centralized in the packing industries of the West. It has been stated upon good authority that 30 per cent of the cotton-seed oil now manufactured in the United States is purchased by packing houses, and utilized in the manufacture of various substitutes for lard. In fact, the price of this oil is now largely regulated by the fluctuations in the price of lard. Subsequent important uses to which this product has been put are as a substitute for olive oil in the packing of sardines and similar fish, as an ingredient in the manufacture of artificial butter, and for giving a "natural" butter color to oleomargarine. In addition to its edible uses, cotton-seed oil has been adapted to many others. The residue from processes of refining and finishing the oil, and oil made from damaged seed, are largely utilized in the manufacture of a soap valuable for wool scouring and other purposes, and in extensive demand both at home and abroad. The cylinders of phonographs are also made from this residue, and an excellent laundry soap results from its combination with other greases. An oil bleached white by sulphuric acid and mixed with petroleum for use in miners' lamps is made from the lowest grades of the crude oil. Candles, glycerine, and various other products are also manufactured from oil expressed from cotton seed.

From the foregoing, it becomes apparent that the chief use of cotton-seel oil is in the preparation of human food. Practically, all the high grades are utilized for edible purposes. Besides its important monopoly as a substitute for lard, it is a strong competitor in the channels of trade with oils of the olive, the peanut, and the cocoanut. On the other hand, the industrial uses of cotton-seed oil are, with few exceptions, comparatively limited, or are confined to products manufactured from off-grade oil, or to the residue from refining. In the three great

industrial uses of oils, illumination, painting, and lubrication, cotton-seed oil is not an important factor. As an illuminant, its use is confined principally to the miner's lamp. Its deficiency in drying qualities has thus far interfered with its commercial success as a substitute for linseed oil in paint, and as a lubricant it is limited to the most ordinary uses, no process having yet been found for eliminating the gum which makes it objectionable for general lubricating purposes. The chief industrial use of cotton-seed oil is for soap making, and for this purpose it has a large domestic and foreign demand.

BY-PRODUCTS FROM MANUFACTURE OF COTTON-SEED OIL.

The by-products from the manufacture of cotton-seed oil have a combined money value almost equal to that of the oil itself, but their uses are less varied. With one unimportant exception their greatest utility has gradually been demonstrated to be confined to cattle feeding. Upland cotton seed, the principal source of cotton-seed oil in the United States, is covered, as delivered for the oil-making process, with a fuzzy coating of short lint; for, on account of the tenacity with which the commercial staple adheres to the seed the ordinary process of ginning for the purpose of obtaining this staple fails to remove it cleanly from the seed. Upon an average, about 70 pounds of short or broken lint adheres to each ton of ginned seed. At the oil mills the first process to which the seed is submitted, after cleaning it from sand and other foreign substances, is reginning, for the purpose both of removing an oil-absorbing substance and of effecting an economy in saving a part of this inferior lint. Under ordinary conditions about 30 pounds of short lint are obtained from each ton of seed. From the seed of a cotton crop of 10,000,000 bales there could thus be effected a saving, assuming that the entire crop were used, of about 300,000 bales of short lint, which, at an average price of $15 a bale, would amount to $4,500,000.

COTTON-SEED HULLS AND OIL CAKE.

Cotton-seed hulls.—The only other, but by far the most important, by-products from the manufacture of cotton-seed oil are cotton-seed hulls and cotton-seed cake, both, the latter especially, of great economic and commercial value as cattle food. After the process of reginning, the cotton seed is run through hulling machines, which cut it to pieces and screen the hulls from the meats. Very nearly one-half of the entire weight of the seed is thereby converted into the marketable product known as cotton-seed hulls. In the early years of the industry this by-product was used solely for fuel, one ton of hulls being about equal in fuel value to one-quarter of a ton of coal; and practically the entire motive power of the early mills was derived from this source. In recent years the use of hulls for fuel has been

totally abandoned. It has been practically demonstrated that, mixed with cotton-seed meal, they are of superior value as a food for cattle, and for this purpose a steady demand now exists throughout the Southern States for the entire supply. When cotton-seed hulls are worth the fair price of $3.50 a ton, there would result a value of about $8,000,000 from the utilization of the possible outturn of hulls from a 10,000,000-bale cotton crop.

COTTON-SEED OIL CAKE.—As is the case in the manufacture of peanut oil and cocoanut oil, only the meats of cotton seed are utilized for oil extraction. These, under ordinary conditions, constitute almost exactly one-half the entire weight of the seed—1,000 pounds of meats to every short ton of seed. Their oil content naturally varies with the conditions of soil, season, etc., where the seed is grown; but, as a general rule, it is about the same as that of flaxseed. The yield of oil is, under fair conditions, about 30 per cent of the weight of the meats, or about 300 pounds of oil (40 gallons) to every 1,000 pounds of meats. The residuum, after the expression of the oil (700 pounds out of every 1,000) constitutes the well-known commercial product, cotton-seed cake, or, as it is called when ground for feeding or fertilizing purposes, cotton-seed meal. This by-product contains nitrogenous properties of great fertilizing value, and is, moreover, when used as a mixed ration, one of the most valuable of cattle foods, containing on an average 43.26 per cent protein, 22.31 per cent nitrogen-free extract, and 13.45 per cent fat. Next to the oil itself, this is commercially the most valuable product of cotton seed. It usually commands a price, pound for pound, about one-fourth that of the oil; and hence the proceeds from the oil manufactured from a ton of cotton seed are, at the best, not more than double the returns from the cake. For use both as a fertilizer and for feeding purposes there has been a steady demand for this product ever since the inception of the industry. Until within the last twenty years, however, the use of cotton-seed cake and meal as a cattle food was not practiced to any great extent in the United States. The bulk of these products was exported to Europe and competed successfully in the European markets, as a cattle food, with like by-products of flaxseed. In fact, the identical uses to which cotton-seed cake and linseed cake were put are suggested by the fact that previous to 1895 they were not separated in statements of exports. The early domestic demand for cotton-seed cake and meal was, on the other hand, almost exclusively for fertilizing purposes, and was confined chiefly to the Southeastern States, where continuous cropping of the soil had made fertilizing a necessity. But since the remarkable development of the cotton-seed industry in Texas cotton-seed meal, mixed with cotton-seed hulls and mill feeds, has been extensively adopted as a fattening food for cattle in the Southwestern States. Several hundred thousand head of cattle fattened upon this product

are shipped thence each year, and its use as a feed has now become popularized to a limited extent throughout the entire South. The bulk of the cotton-seed cake and meal manufactured in the United States is, however, still exported. During the past three years an average of almost three-fourths of the total product has been shipped abroad. It is somewhat remarkable that the total domestic consumption of this product, as deduced from trade statistics of production and exports, shows so little increasing tendency. During the period from 1895 to 1901, the only years in which exports of cotton-seed cake and meal are given separately in statements of exports, domestic consumption seems to have remained fairly steady, with no tendency to increase at all commensurate with the growth of manufacture. Evidently high prices and a heavy export demand were the primary causes of this state of the trade. There can be little doubt that there is a tendency to an increase in the use of this product in the Southern States for feeding purposes, and that larger and larger quantities are annually being diverted from employment as a fertilizer to use as a cattle food. Practical economy has demonstrated that its full value is best realized in the cattle-feeding industry. To indicate the possibilities in the cotton-seed crop of the South it may be noted that, at the low price of $20 a ton, the cake or meal alone from the seed, if all were utilized, of a 10,000,000-bale cotton crop would have a value of about $35,000,000.

PRESENT STATUS OF THE COTTON-SEED INDUSTRY.

The impetus thus given to the cotton-seed industry during the first thirty years of its existence has gathered even greater force within the past few years. Since 1897, 200 additional mills, approximately, have been constructed in the cotton-growing States, making a total of about 500 now manufacturing oil. Texas maintains its supremacy in the industry with a crushing capacity embracing about one-third of the total number of mills. Georgia, South Carolina, and Mississippi are each of almost identical importance in the manufacture, and, combined, have about 40 per cent of the total number. Alabama, Louisiana, and North Carolina, in the order of their rank in the business, have between 30 and 40 mills each. Upwards of 20 mills are located in each of the States of Arkansas and Tennessee, and the remainder are distributed in numbers ranging from one to nine each in Virginia, Florida, Missouri, Oklahoma, and Indian Territory. Although the crushing capacity of the Southern States has been increased by about one-third within the past few years, the mills, during the seven months of the year in which they operate, utilize only about 50 per cent of the entire crop of seed. It should be observed, however, that the increase in the number of oil mills from 1897 to 1901 has been attended and partially offset by an increase of from 25 to 30 per cent in the quantity of

seed annually produced; and hence a statement of the percentage of the crop now manufactured, as compared with the proportion utilized a few years ago, falls far short of indicating the true development of the industry. Commercial authorities estimate the proportion of the crop now manufactured at about 50 per cent of the gross quantity produced, against 40 per cent in 1897. But the actual quantities indicated by these percentages are 2,415,140 tons of seed manufactured in 1901 against 1,628,000 tons in 1897, an increase of 49 per cent. Nor must it be assumed that all of the large proportion of the crop unutilized for manufacture could, under any circumstances, be used for that purpose. From this surplus seed must be drawn for planting 25,000,000 to 28,000,000 acres of cotton—seed, it should be noted, of a somewhat bulky nature, weighing only from 30 to 33 pounds to the measured bushel, and sown by an extremely wasteful method, an inch apart in the rows, 90 per cent of the growing plants to be afterwards "chopped" out in thinning. Also, the hereditary habit, among many cotton growers, of carelessly handling this formerly waste product, together with its ready susceptibility to ruinous damage from rain or moisture, doubtless unfits considerable quantities yearly for manufacturing purposes. Cotton seed in its natural state, too, is still used, perhaps, to a small extent as a fertilizer in localities remote from mills. In short, there is practical unanimity among commercial authorities that not far from two-thirds of the annual cotton-seed crop actually available for manufacture is now converted into oil and other products. The steady demand, both foreign and domestic, that has been firmly established for cotton-seed oil, oil cake, and meal, and, more potent still, the high prices that cotton seed itself now commands in the primary markets, are influences furnishing a stimulus to this industry that doubtless will very soon result in the manufacture of every available pound of cotton seed raised in the Southern States.

BENEFITS OF THE COTTON-SEED INDUSTRY TO THE COUNTRY.

The benefits accruing to the country from this industry are of a diversity that can scarcely be conceived. In it a capital of over $100,000,000 has been invested and distributed throughout the Southern States. As a result, good markets now exist in hundreds of Southern cities and towns for an agricultural product that within the memory of middle-aged men was notable chiefly for its unadaptability to profitable uses. Tens of thousands of laborers, almost exclusively of the resident negro race, now find employment in the manufacture of cotton-seed oil and in the various occupations directly incident to the industry. In the two chief products, oil and oil cake, or meal, a foreign export trade has been established that returns to the South annually from $25,000,000 to $30,000,000, and the domestic trade is not greatly inferior. Naturally, allied industries have sprung up near

the sources of supply for their raw material. Fertilizer factories, utilizing cotton-seed meal as a source of nitrogen in mixing fertilizers, effect economies by combining with or locating near the oil mills. Cattle feeding, especially in the States west of the Mississippi, has been found by cattle feeders a profitable adjunct to the mills, and is practiced on a large scale. Oil refining, which was formerly done almost exclusively by the Western packing houses, the crude oil being shipped thither from the South, is now carried on extensively by the oil mills themselves. The grinding of oil cake into meal, in a manner an allied industry of oil making, is also largely confined to the cotton-seed oil mills. It is notable, too, that, in the trend of modern business methods, combinations of the capital invested in this industry have been made for the purpose of effecting economies in the manufacture from the raw material and of regulating trade in the manufactured products. Uniformity of prices has been established throughout the South for a product of the cotton fields that, even a few years ago, was valued, according to locality, either by the whim of the purchaser or by the keenness of competition. Cotton seed is now quoted, bought, and sold on Southern cotton exchanges after the manner that grain is on the boards of trade and produce exchanges of the North and West. In fact, the cotton-seed industry, originally based upon the chance discovery that a cumbersome and unsalable by-product of the cotton belt was rich in oil valuable chiefly for adulterative purposes, has now been transformed into a separate, distinct, organized business, and its manufactured products are sold extensively, both in foreign and domestic markets, on their own merits, for a great variety of purposes. The cotton-seed crop is now an important entity in the agriculture of the country, and has the distinction of being the most valuable oleaginous seed crop produced in the United States.

THE FIRST OFFICIAL INVESTIGATIONS OF THE COTTON-SEED INDUSTRY.

As would naturally be expected in an industry of marvelously rapid development, investigations into its agricultural, industrial, and commercial features have not kept pace altogether with the growth of the industry. At the taking of the census in 1890 the cotton-seed industry was for the first time made a subject of official investigation, but only to the extent of ascertaining the quantity and value of seed actually marketed for all purposes in the census year. The average price per ton sold in 1889–1890 was found to be $8.54. The census of 1900 has somewhat amplified the scope of investigations, and has published an estimate of the entire crop of cotton seed produced in the census year and also in the year following. The estimates, however, are not based upon inquiries on the spot, but upon the estimated yield of lint cotton. It is generally accepted that seed cotton as picked from the boll consists in weight of one-third lint and two-thirds seed, and

upon this basis the gross cotton-seed crop of 1899–1900 is given in the reports of the Twelfth Census at 4,668,346 tons and that of 1900–1901 at 4,830,280 tons of 2,000 pounds each. The total value of the crop has been estimated by the Census Office by multiplying the total quantity produced by the average price at which the portion marketed was purchased by the cotton-seed mills. This price has been found to be $11.55 per ton in 1899–1900 and $16 per ton in 1900–1901, an increase in the latter year of almost 100 per cent over the price in 1889–1890. The investigations of the Census Office constitute the only official statistical information extant upon the agricultural and industrial features of the industry. Information as to the commercial features are readily obtainable, so far as the foreign commerce is concerned, from custom-house statements, but statistics of the internal commerce in the products of cotton seed lack classification by official authority. In this industry, however, as in many others, the possession of a few fundamental facts makes possible an exposition, along broad lines, of many phases of its growth, development, and present magnitude. As has been seen, from the total yield of cotton for any given year a fairly accurate estimate can be made of the total crop of cotton seed. The quantity of cotton seed raised having been thus ascertained, it is equally well known that under average conditions the yield of the two important products, oil and oil cake, will be oil, about 40 gallons (300 pounds), and oil cake, about 700 pounds, from each ton of seed. Evidently it is only necessary to know what proportion of the total cotton-seed crop is actually manufactured each year to determine in a general way the quantities of the products manufactured. This proportion has been calculated by competent commercial authorities familiar with the trade. For the year 1899–1900 the figures of the Twelfth Census upon cotton seed and its manufactured products are also available. Incidentally, it should be noted that, although the Census Office has published estimates of the total quantity of cotton seed produced in both 1899–1900 and 1900–1901, information as to the proportion of the crop actually utilized for manufacture and as to the quantity of oil and oil cake produced is furnished by that authority only for 1899–1900, the census year proper. Complete data having the sanction of official authority are available in this industry only for that year. The census investigations disclosed the fact that 53.1 per cent of the cotton-seed crop of 1899–1900 was utilized in manufacture; the average yield of oil per ton of seed manufactured for the entire country during that year was 37.6 gallons; the yield of oil cake, 713 pounds per ton. These figures indicate that the commonly accepted commercial estimates upon this industry for previous years were fairly close approximations. The table following, therefore, gives the total cotton-seed crop, the percentage of the crop utilized in manufacture, the quantity of seed actually manufactured, the gallons of oil and tons of oil cake produced,

the exports of oil and oil cake and meal, and the quantities of oil retained for home consumption from 1872, when exports of cotton-seed oil were first given separately in export statements, up to the present time:

Statistics of the cotton-seed industry of the United States.

Year ended June 30—	Cotton-seed crop	Percentage of crop manufactured.	Seed manufactured.	Oil produced.	Oil cake produced.[a]	Oil exported.	Oil retained for home consumption.
	Tons.	*Per cent.*	*Tons.*	*Gallons.*	*Tons.*	*Gallons.*	*Gallons.*
1872	1,317,637	4	52,705	2,108,000	18,400	547,165	1,560,835
1873	1,745,145	3	52,354	2,094,000	18,300	709,576	1,384,424
1874	1,851,652	4	74,066	2,963,000	25,900	782,067	2,180,933
1875	1,686,516	5	84,325	3,373,000	29,500	417,387	2,955,613
1876	2,056,746	6	123,404	4,936,000	43,200	281,054	4,654,946
1877	1,968,590	5	98,429	3,937,000	34,400	1,705,422	2,231,578
1878	2,148,239	7	150,376	6,015,000	52,600	4,992,349	1,022,656
1879	2,268,147	8	181,451	7,258,000	63,500	5,352,530	1,905,470
1880	2,615,608	9	235,401	9,416,000	82,400	6,997,796	2,418,204
1881	3,038,695	6	182,321	7,293,000	63,800	3,444,084	3,848,916
1882	2,455,221	12	294,626	11,785,000	103,100	713,549	11,071,451
1883	3,266,385	12	391,966	15,679,000	137,200	415,611	15,263,389
1884	2,639,498	15	395,924	15,837,000	138,500	3,605,946	12,231,054
1885	2,624,835	19	498,718	19,949,000	174,500	6,364,279	13,584,721
1886	3,044,544	19	578,463	23,138,000	202,400	6,240,139	16,897,861
1887	3,018,360	23	694,222	27,769,000	243,000	4,067,138	23,701,862
1888	3,290,871	25	822,717	32,909,000	287,900	4,458,597	28,450,403
1889	3,309,564	24	794,295	31,772,000	278,000	2,690,700	29,081,300
1890	3,494,811	25	873,702	34,948,000	305,800	13,384,385	21,563,615
1891	4,092,678	25	1,023,169	40,927,000	358,100	11,003,160	29,923,840
1892	4,273,734	25	1,068,433	42,737,000	374,000	13,859,278	28,877,722
1893	3,182,673	33	1,050,282	42,011,000	367,600	9,462,074	32,548,926
1894	3,578,613	40	1,431,445	57,258,000	501,000	14,958,309	42,299,691
1895	4,792,205	35	1,677,271	67,090,840	587,044	21,187,728	45,903,112
1896	3,415,842	42	1,434,653	57,386,120	502,128	19,445,848	37,940,272
1897	4,070,100	40	1,628,040	65,122,000	569,800	27,198,882	37,923,118
1898	5,252,767	40	2,101,106	84,044,000	735,300	40,230,784	43,813,216
1899	5,471,521	43	2,352,754	94,110,000	823,400	50,627,219	43,482,781
1900	4,668,346	53	2,479,386	93,325,729	884,391	46,902,390	46,423,339
1901	4,830,280	50	2,415,140	96,605,600	845,299	49,356,741	47,248,859

[a] Exports of oil cake since 1895 have been as follows (in tons of 2,000 pounds): 1895, 241,858 tons; 1896, 202,463 tons; 1897, 311,693 tons; 1898, 459,863 tons; 1899, 539,996 tons; 1900, 571,852 tons; 1901, 629,343 tons.

THE WORLD'S TRADE IN COTTON-SEED OIL AND OIL CAKE.

The United States, though not possessing exactly a monopoly of the manufacture of cotton-seed oil and oil cake, practically controls the world's trade in these products. No other cotton-producing country is engaged to any noteworthy extent in this industry; and attention has already been called to a perishable quality of cotton seed that tends to limit its use for manufacturing purposes closely to the countries where grown. It happens, however, that the lint of the long-staple

cotton grown in Egypt, like that of the sea-island cotton of the United States, does not adhere tenaciously to the seed; it is completely removed by the ginning operation, leaving the seed smooth, lintless, and, hence, less liable to heat and damage in storage or in transportation than is the upland cotton seed of America. This characteristic of the Egyptian seed had made possible the profitable establishment of cotton-seed oil mills in England and France long before the industry had assumed importance in this country. Until about 1880, England, though crushing then only about 200,000 tons of seed annually, was the leading cotton-seed oil producer of the world; in fact, as late as 1890, the quantity of cotton seed crushed in England was 43 per cent of that crushed in the United States. The liability, however, even of lintless seed to heat and to deteriorate in the holds of vessels is, with other causes, likely to prove a permanent obstacle to further important extension, in noncotton-producing countries, of this trade. It is notable that from 1890 to 1901, a period during which the quantity of seed crushed in the United States was almost trebled, the increase in the quantity crushed in England was less than 30 per cent. The English mills are now about twenty-five in number, three-fourths of them located at Hull, the largest single cotton-seed crushing center in the world. These mills, all told, utilize about 400,000 tons of seed annually, 85 to 90 per cent of it being drawn from Egypt. Also, practically all cotton seed exported from the United States, amounting, however, to only 15,000 to 20,000 tons annually, is taken by the English mills. In France, the cotton-seed industry is confined to the city of Marseilles, where the five mills now in operation crush annually from 40,000 to 50,000 tons of seed. The French mills, as is the case with those in England, draw their supplies of raw material principally from Egypt, and crush seed without decortication, thereby producing an oil inferior to that produced in the United States from seed fresh from the fields; the mills in France also refine large quantities of American oil. The weakness of foreign competition in this industry, however, is indicated by the fact that the English and French mills, combined, crush annually less than one-fourth the quantity of seed crushed in the United States.

EXPORTS OF COTTON-SEED OIL AND OIL CAKE.

COTTON-SEED OIL.—The consumption of cotton-seed oil in the United States is greater than that of any other single country. In recent years it has averaged over 40,000,000 gallons annually. Domestic consumption, however, of late does not seem to be greatly increasing, and the heavy increase in production has been absorbed chiefly by the foreign demand. Notwithstanding the large quantities required for domestic uses, about one-half of the oil manufactured in this country is now exported; and from 85 to 90 per cent of the exports are for European destination. France

and Holland, combined, have for many years taken, as a general rule, about one-half the total quantity exported—the former, large quantities of low-grade oils for refining, or for use in soap manufacture, also some high grades for various edible purposes; the latter, chiefly high grades of summer yellow or "butter" oil for the manufacture of artificial butter. In the order of their importance as purchasers the position of these countries has in recent years been reversed. For some years previous to 1896 Holland's takings were about treble in quantity those of France; but, since that date, though the trade of each has greatly increased, that of France has advanced with giant strides, and now absorbs annually about one-third, whereas Holland takes but from one-fifth to one-sixth of our total exports. The increase of the trade with France, though it declined somewhat in 1900, has been the most striking feature in the history of our European commerce in this product. Austria-Hungary, Germany, and the United Kingdom are next in importance as purchasers, taking together, however, less than 30 per cent of the total exports, or, in 1900, the record year, something over 4,000,000 gallons each. The only other European customers of notable importance in this trade are Italy and Belgium, whose takings in 1900 amounted, respectively, to 2,660,000 and 1,915,000 gallons. As to the trade in cotton-seed oil with countries on this side of the Atlantic, the most notable feature is the increase in shipments to Mexico, these having steadily increased from 200,000 gallons in 1891 to 4,000,000 gallons in 1900. An increasing trade is also being established with some of the South American republics, notably with Brazil and Argentina, but annual shipments to all countries of the South American continent have remained steadily less than one-half the annual consignments to Mexico. An export trade in this product, moreover, is now carried on on smaller scales with various countries of all continents, and the total exports of cotton-seed oil from the United States for the past three years have averaged, in cash value, $14,000,000.

COTTON-SEED OIL CAKE.—One of the most notable features of the cotton-seed oil industry, and the last of which it is possible to speak within the limits of this article, is the limited consumption in the United States, as compared with that in certain European countries, of cotton-seed oil cake and meal as a cattle food. Although considerable quantities of this product are now fed in some sections of this country, only about one-fourth of the quantity manufactured in the United States during the past two years has been retained for home consumption; moreover, a large proportion of this, possibly one-half, has been utilized for mixing fertilizers. The remaining three-fourths have been exported, and of these heavy exports, three countries of Europe have taken about 85 per cent. Germany, the principal customer for this product, has alone drawn a larger quantity from the

United States than they themselves consumed. England, whose finely-bred herds consume a larger quantity of cotton-seed cake and meal than do those of any other country on earth, supplements her own supplies annually by drafts upon the United States amounting now in quantity to over three-fourths of our own consumption. Denmark, the fame of whose dairy industry is world-wide, shows a growing appreciation of this valuable animal food, and her takings from the United States have increased from 10,000 tons in 1896 to 137,000 tons in 1900. Holland and France, though comparatively much less important as customers, complete the list of European countries participating to noteworthy extent in this trade. The principal cis-Atlantic participants in the small balance of the trade are the Dominion of Canada and the West Indies. The value of the total export trade in cotton-seed oil cake and meal for the past three years has averaged $11,000,000 per annum. Notwithstanding the high prices that this product now commands, its greatest economic value would undoubtedly be realized by larger use as a domestic cattle food, thereby not only realizing its full value as a feed, but also returning its rich fertilizing properties to the soil.

The foreign demand for both cotton-seed oil cake and meal and linseed oil cake and meal—identical products so far as their uses as feed are concerned—indicates a much greater appreciation of their economic value abroad than is apparent at home. The combined exports of these commodities constitute in money value the most important item of animal food, with the exception of corn, shipped out of the United States. And whereas the annual exports of corn have at the maximum never exceeded 11 per cent of the crop, the popularity of these oil-seed products upon foreign markets is attested by the fact that of late years from 60 to 75 per cent of the entire quantities annually manufactured have been sent abroad. During the period 1895 to 1901, both inclusive, the aggregate exports of these by-products of cotton seed and flaxseed amounted in value to over $87,000,000; the aggregate exports of corn during the same period amounted to over $417,000,000. Or, the exports of animal food from the corn crop, the foremost crop of the United States in domestic value, were only four times in value the exports of animal food from oil-seed crops, the combined domestic value of which was not one-tenth that of corn. Moreover, the foreign demand for these oil-seed by-products indicates that in the principal purchasing countries they are steadily coming to be regarded as more and more indispensable as a food for cattle. Their takings from the United States are, unlike the takings of corn, apparently unaffected by ordinary crop variations or by fluctuations in prices. From a value of $7,165,587 in 1894–1895 the combined exports of cotton seed and flaxseed cake and meal increased steadily to a value of $18,591,898 in 1900–1901. For few products of the American farm

has the foreign demand during the same period shown so steady and so constant an increase. Only the remarkable growth of the cotton-seed industry has made possible the satisfying of this increasing demand. From 1894–1895 to 1900–1901, the only period for which separate data are available, the exports of linseed oil cake and meal increased over 85 per cent, the last three years of the period, however, showing a decidedly declining tendency. During the same seven-year period exports of cotton-seed cake and meal increased upward of 155 per cent, each year of the entire period showing an increase over the one preceding.

INFLUENCE OF ENVIRONMENT ON THE CHEMICAL COMPOSITION OF PLANTS.

By Dr. H. W. Wiley,
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The term "environment" as used in this paper includes the soil in which the plant grows, the fertilizers which are added thereto, the character of the cultivation to which the crop is subjected, and the climatic influences obtaining during the period of growth. Within the space of a Yearbook article it would be manifestly unwise to attempt a discussion of all these factors. It is evident that before a complete idea can be formulated representing the sum of our knowledge on the influence of environment each factor of the problem should be studied in such a way as to determine, if possible, its influence upon the general result produced.

Since the beginnings of agricultural chemistry it has been recognized that plants of the same species, and even of the same kind, undergo great variations in composition from season to season and from decade to decade. It has also been known that these variations are produced chiefly by the environment, and in a general way the factors most potent in these changes can be recognized. It is the purpose of this article to deal chiefly with the studies in this direction which have been conducted by the Bureau of Chemistry and its predecessor, the Division of Chemistry, on the composition of plants as affected by environment.

Early Studies on the Composition of Plants.

In the earliest studies of the Division of Chemistry on the composition of plants and plant products attention was called to the variations mentioned. This was especially true of the early studies of the products of fermentation, viz, wines and ciders, and, a few years after these, the studies of the composition of the sugar beet when it was first introduced in a practical way into the United States as a sugar-producing plant. These studies, however, were of a desultory nature, and were not conducted with any definite plan for ascertaining the magnitude of individual factors. Subsequently, when sorghum was presented as a promising sugar-producing crop, more extensive investigations were made in regard to environment. As a result of these

investigations certain localities were designated in the United States where the sugar content of the sorghum plant appeared to reach a maximum. One of these localities was in the State of Kansas, and this State was selected by reason of this fact as the locality best suited to rigid scientific experiments in increasing the content of sugar. These researches were conducted under the direction of the Division of Chemistry and under the personal supervision of Mr. A. A. Denton for a period of many years, and the results thereof were published in numerous bulletins and summarized in Bulletin No. 40 of that Division. Altogether it is estimated that about half a million analyses were made in securing the final data contained in that bulletin.

It was demonstrated in this work that in the environment obtaining in Kansas it is possible, by a judicious scientific culture, to gradually—in fact, at first rapidly—increase the content of sugar in the sorghum plant. At the beginning of the experimental work this content of sugar was scarcely 10 per cent, and at the end, in certain varieties which were established, it was as high 14 per cent.

During this same period and subsequent thereto extensive investigations were continued in determining the influence of environment upon the composition of the sugar beet. The first work of this kind was done under the direction of Dr. William McMurtrie, Chemist of the Department of Agriculture from 1873 to 1878, and under his supervision the first agricultural map ever constructed by the Department of Agriculture was published, showing the probable localities in the United States in which the environment was suitable to the production of beets of a high grade. A few years after this a soil map of the State of California was published by Professor Hilgard and republished by the Department of Agriculture in Bulletin No. 5 of the Division of Chemistry. The areas mapped in general by Professor Hilgard of the soils of California were selected by reason of the environment therein being favorable to the production of large quantities of sugar in the beet.

Recent Studies of Influence of Environment on Composition of Plants.

The general principles of the influence of environment having thus been established both by workers out of and in the Department, it seemed advisable to undertake the study in a more definite and scientific manner. This study has been directed in the last few years to the following investigations: First, the influence of environment on the chemical composition of cereals, and second, the influence of environment on the chemical composition of sugar-producing plants, including under this a substudy of the influence of environment on the composition of cantaloupes and muskmelons.

CEREALS AS INFLUENCED BY ENVIRONMENT.

INITIAL STEP IN SCIENTIFIC STUDY OF CEREALS.

An elaborate study of the composition of cereals as affected by environment was commenced in the Division of Chemistry in 1882 by the assistant chemist, Mr. Clifford Richardson, and continued for several years. Most valuable data were obtained during these investigations, and they were published in Bulletins Nos. 1, 4, and 9 of the Division of Chemistry. Two methods of investigation were employed. In the first place, samples of cereals grown in all parts of the United States and in Europe were analyzed wherever such samples could be obtained by the Department of Agriculture, and these analyses were compared with other analyses made in other laboratories and in other countries. As a result of a comparison of these analyses certain conclusions were reached relating to the influence of environment upon the composition of cereals in general.

There were two important sources of weakness in a study of this kind, which were clearly recognized by the investigator in charge, but which he had, at that time, no means of correcting. The first of these consisted of the fact that the methods of analysis in vogue among agricultural chemists at the time were very different and led to widely varying results. There was no uniformity of procedure, but each chemist followed that method of analysis which seemed to him best. It is evident, therefore, that a comparison of data obtained in this manner would not have the value which would attach to it were the analyses made by uniform methods.

The second objection to this method of study was found in the fact that samples of widely different varieties were brought into comparison, grown under widely different conditions of culture and fertilization and in soils which in themselves varied greatly in their chemical composition. Hence, the deductions which could be obtained from a comparison of such miscellaneous analyses, while valuable in many respects as showing definite areas of influence, were not wholly conclusive. To remedy this difficulty, Mr. Richardson pursued the truly scientific plan of sending seeds of the same kind and of known composition to different localities, having them grown therein, and the samples thus secured returned to the Department for analysis. Thus, the analytical methods which obtained in the examination of the original seeds were also applied to the crops grown from those seeds, and the first really scientific step was taken toward a direct study of the sum total of the changes produced by the environment in the different localities.

STUDY OF WHEAT.

It was in this way shown that seeds of wheat of very many different varieties, which were sent to Colorado for growth, tended to produce a crop which, upon the whole, was richer in nitrogenous matters, or

protein, than the original seeds, whereas the same seeds sent to Oregon, parts of California, and North Carolina exhibited a tendency to produce crops in which the percentage of protein matter was decidedly lower than the original. Thus, the general conclusion was justly drawn that the environment of Colorado had the power to affect the composition of the wheat by increasing its nitrogen content, and it was shown that this increase was made at the expense of the carbohydrate content of the wheat.

On the contrary, the environment of Oregon, California, and North Carolina operated in exactly the contrary direction, increasing the carbohydrate content of the wheat at the expense of the nitrogen.

Mr. Richardson made the following observations upon the data obtained from Colorado, the experiments there having been conducted under the personal direction of Prof. A. E. Blount:

The average composition of the seed is, to begin with, remarkably good, showing that they were of fine quality, or at least a majority of them. The average for the crop shows a slight gain over the seed in ash, no change in oil, a slight loss in starch, and slight gain in fiber and albuminoids. The first question that arises is, Why have the albuminoids failed to improve more? This is explained by a study of the analyses separately. It has been shown that the average amount of albuminoids found in Professor Blount's wheats of 1881 from domestic sources was 13.04, and in the analyses of the 1882 crops it will be seen that those which were from seed containing high amounts of albuminoids fell toward the average figure, while those low in albuminoids had a tendency to rise toward it; that is to say, six increased and six decreased their albuminoids, the average agreeing with that of 1881, which seems to point to the fact that the Colorado soil has a capacity for supporting a percentage of albuminoids in a wheat of about 13, and that if a variety in the seed has more than this it will tend to decrease to that figure, and vice versa. For example: A wheat having 16.11 per cent in the grain sown contained only 14.91 per cent in the grain harvested, and one having 9.65 in the seed increased to 12.15 per cent; but of course a fall happens much more readily than the reverse. The Washington Glass variety, having only 11.86 per cent of albuminoids in the seed, failed to improve; but this is owing to an inherent dislike of this wheat wherever it grows to assimilate nitrogen, a peculiarity which Colorado could not overcome.

In the other constituents the ash increased in nine cases out of twelve, the new soil furnishing a large supply of mineral food—the oil in 7 and the fiber in 11 cases. The increase of the latter seems to be a common accompaniment of flourishing growth. In every case the size and general appearance were much improved, and as a consequence the weight of 100 grains of the crop was much heavier than of the seed; in fact, averaged over 26 per cent heavier.

Of the 44 wheats from Colorado grown during two years only 1 fell below 11.5 per cent of albuminoids and only 6 below 12 per cent. Only 2 of this number weighed less than 4 grams per hundred grains. In North Carolina, on the contrary, 22 of whose wheats were analyzed, only 2 exceeded 12 per cent of albuminoids, while the weight of 100 grains averaged as high as 3.776. In Oregon another phase is presented, as has been before mentioned. Out of 8 wheats which were analyzed by us none contained more than 9.47 per cent of albuminoids or weighed less than 4.253 grams per hundred grains. In Virginia a stunted wheat was found weighing only 1.830 grams per hundred grains, and yet having 14 per cent of albuminoids. The effect of locality is well represented by these few facts, and the necessity for a determination of the weight of 100 grains is apparent when a few of these exceptional analyses are printed side by side.

Mr. Richardson was of the opinion, as a result of these studies, that the soil was the most important factor in producing these variations. A subsequent study of the Department, which will be referred to later on, seems to show that, in this respect, he was mistaken, and that the soil, as a rule, has the least effect of all the important factors of environment upon chemical composition, provided, of course, that it contains the essential elements of plant food necessary to produce an average crop. The soil, it is true, is one of the most potent factors in determining the size of the crop and the amount of material which is harvested, but it does not have a very marked influence on the chemical composition of the crop produced.

STUDY OF INDIAN CORN.

The same method of study was pursued, though less extensively, with Indian corn. As a result of his study on the influence of environment on Indian corn, Mr. Richardson says:

In the averages for different sections of the country another fact is discovered which, after our experience with wheat, is still more surprising than the result of the comparison of American and foreign corns.

There is apparently the same average amount of ash, oil, and albuminoids in a corn wherever it grows, with the exception of the Pacific Slope, where, as with wheat, there seems to be no facility for obtaining or assimilating nitrogen.

The amount of water is variable, but, as has been said, many of the samples had been on exhibition for a considerable time, and were consequently dried out.

The increase in the fiber from east to west is not paralleled in the wheat, but, as we have seen, is often a feature of increased vigor.

Corn is, then, an entirely different grain from wheat. It maintains about the same percentage of albuminoids under all circumstances, and is not affected by its surroundings in this respect.

A study of the averages for each State shows that the samples from Pennsylvania and from Oregon and Washington Territory fall much below the average, and that those from New Hampshire rise above it. The preponderance of averages for single States, which do not vary 1 per cent, proves, however, that corn is much more stable in its composition than wheat, even though New Hampshire contains an extreme of 11.67 per cent average albuminoids, and Pennsylvania, Oregon, and Washington Territory extremes of 8.88, 8.40, and 7.88 per cent. Only two analyses have been made from the Pacific Slope, and more are needed for confirmation, but as the two analyses, like those of the wheats grown here, are low in albuminoids, it may safely be assumed to be a characteristic of that portion of the country.

Having discussed the averages, it is of interest to see how wide the variations in composition are:

Variations or extremes for each constituent of corn.

Constituent.	Highest.	Lowest.	Variation.	Above average.	Below average.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Water	15.10	7.40	7.70	5.06	8.64
Ash	2.10	1.18	0.92	0.58	0.34
Oil	7.49	3.92	3.57	2.29	1.28
Carbohydrates	75.73	65.97	9.76	5.04	4.72
Fiber	3.10	0.78	2.32	1.01	1.31
Albuminoids	13.65	7.00	6.65	3.19	3.46
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Weight of 100 kernels	53.679	23.605	29.074	15.769	13.305

The variation in water has been explained; that of ash is remarkably small, of oil and fiber proportionately the same as in wheat, while albuminoids have not nearly so wide a variation—and, in fact, in the analyses of the 114 corns only 3 contain less than 8 per cent, 2 more than 13 per cent, and 7 more than 12 per cent—so that the usual limits may be said to lie between 8 and 12 per cent, and this is true of the analyses of foreign maize given by Koenig.

Our conclusion must be, then, that corn can supply itself with nitrogen under varied circumstances, but that it rarely is able to assimilate more than a certain amount, nor will it fall far below this amount. The bushels of crop may vary, and the size of the grain, but the quantity of albuminoids is practically unchangeable.

It is probable that some portions of these deductions will have to be changed in the light of subsequent investigations, but it is evident that Indian corn, growing as it does over the whole of the United States, is one of those crops which tends more than any other to maintain a uniform composition and to vary less under environment. It is this characteristic of Indian corn which enables it to be grown with success under such widely varying conditions.

SPECIAL INVESTIGATION OF THE COMPOSITION OF CEREALS.

Under authority of Congress a special investigation was undertaken by the Division of Chemistry to determine the effect upon the chemical composition of cereals of different conditions of growth.

PLAN OF SPECIAL INVESTIGATION.

In this special investigation, the plan first proposed for the investigation of cereals was elaborated and carried into greater detail. In general, the plan adopted is as follows: The seed of uniform character is secured and a careful chemical and physical analysis made thereof. This analysis not only relates to the chemical composition of the seed, but also determines its microscopic structure, showing the relation of the cells of different character, as determined by thin sections prepared and mounted in such a way as to admit of microscopic study and photographic reproduction. This seed is then distributed to a number of agricultural experiment stations, widely separated and representing typical conditions of environment in different parts of the country. These seeds are grown as nearly as possible under the same conditions as regards methods of preparing the soil, fertilizers, etc. At the time of harvest the seeds are secured and a portion returned to the Bureau of Chemistry for the purpose of repeating the examination made upon the original seed. Another portion is retained by the station for the purpose of replanting, so as to continue the study of the effect of environment through a number of years.

It is evident that by pursuing this method it will be possible, in the course of a few years, to determine the character of the variations produced by environment, their permanency, and the tendency thereof to produce a plant with distinctly different features from those which

produced the original seed. The collaboration of the experiment stations was readily accorded for these studies, and the following stations undertook the work: California, Colorado, Indiana, Kentucky, Maryland, Missouri, and New York.

The variety of wheat first selected for experimental purposes was an Hungarian wheat known as Theiss. Some of the stations failed to take the necessary steps to secure a crop during the first year, but the California experiment station made up, to some extent, for this deficiency by having the samples of wheat grown at a number of stations in that State.

RESULTS OF ANALYSES OF ORIGINAL SEED AND OF FIRST CROP OF WHEAT GROWN.

In the following table are given the results of the chemical analysis of the original seed and the analysis of the first crop of wheat grown at the several experiment stations:

Composition of original seed and of wheats grown therefrom in different localities.

[Calculated to water-free substance.]

No.	Where grown.	Fat.	Fiber.	Ash.	Proteids.	Pentosans.	Starch (by difference).	Moist gluten.	Dry gluten.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
1	Original seed from Hungary..	2.27	2.83	2.13	15.07	7.44	70.76	31.00	11.26
2	Tulare, Cal	2.62	2.60	2.25	14.00	7.28	71.25	29.55	10.66
3	Paso Robles. Cal	2.39	2.52	2.08	15.10	7.19	70.72	33.91	12.56
4	Paso Robles, Cal................	2.00	2.56	1.83	16.64	7.55	69.42	37.50	13.40
5	Paso Robles, Cal................	2.33	2.59	2.39	17.58	7.84	67.27	40.52	14.90
6	Paso Robles, Cal................	2.20	2.37	2.36	17.86	8.00	67.21	39.97	14.57
7	Pomona, Cal.....................	2.24	2.62	2.66	16.10	7.95	68.43	33.96	12.41
8	Pomona, Cal.....................	2.30	2.55	3.30	15.56	8.05	68.24	31.33	11.42
9	Lexington, Ky..................	2.36	2.58	2.28	13.81	7.29	71.68	30.63	11.83
10	College Park, Md	2.41	2.40	1.77	9.68	7.90	75.84	18.22	6.69
25	Columbia, Mo....................	2.17	2.68	2.03	14.86	7.24	71.02	30.56	11.40
75	Columbia, Mo....................	2.24	2.58	2.03	14.97	7.63	70.55	30.48	11.17

It will be seen from the above table that in the original seed we have a wheat of a reasonably high nitrogen content. It is generally conceded that the value of wheat for milling and bread-making purposes depends more largely upon its nitrogen content than upon any other. It is true that the starch is the most abundant constituent of wheat and offers the largest amount of nutritive food; but the protein, representing the principal part of the nitrogenous bodies, is the substance which gives the wheat its characteristic properties for bread making, because in the protein are found those agglutinating constituents, together known as gluten, which render wheat flour so superior to the flours of other cereals for the purposes of panification.

For the purpose of making a comparison of the data it was thought best to reduce them to water-free substance.

The original seed, as will be seen, contained 15.07 per cent of protein matter. In determining the moist gluten it was found to amount to 31 per cent and the dry gluten to 11.26 per cent.

The largest percentage of proteids found in the various crops was in sample No. 6, where the percentage amounted to 17.86, with a moist gluten content of 39.97 and a dry gluten content of 14.57. The smallest percentage of proteids was found in sample No. 10, where it amounted to 9.68, with a content of moist gluten amounting to 18.22 and a dry gluten of 6.69. It seems scarcely credible that in a single season the environment should cause such a variation in the content of the nitrogenous matter. Sample No. 6, which was grown at Paso Robles, contained almost double the amount of protein and more than double the amount of moist and dry gluten as compared with the sample grown at the Maryland experiment station. It is evident that this wide variation was not due to the character of the soil, nor yet to the character of the fertilizer employed, nor in the method of culture, but depended almost entirely upon the meteorological conditions.

The other constituents of the wheat show a decidedly less percentage of variation. The starch content, for instance, shows only a moderate variability, the smallest content being in sample No. 6, grown at Paso Robles, and the largest in sample No. 10, grown at the Maryland station. The increase in starch in sample No. 10 would be expected, when the low content of protein matter is taken into consideration. These two cases illustrate the general principle of variation in which starch and protein are complementary. The variation in fiber and in the content of pentosan bodies is of less importance. Ash, next to the protein, shows the largest percentage of variation, and it is in this element that the factors depending on soil and fertilizers would have the greatest effect.

A general examination of the table shows:

(1) That the content of wheat in protein matter, and correspondingly in moist and dry gluten, is extremely sensitive to environment of a meteorological nature.

(2) That the starch is also sensitive, but in an inverse ratio.

(3) That the ash, next to the protein, shows a tendency to vary in changing environment, and doubtless the factors most concerned in this are the soil and the fertilizers.

It should be added, however, that the determination of the ash of cereals by the ordinary combustion methods may be extremely misleading, since in some cases the organic sulphur which is present may be completely volatilized, while in other cases a portion of it may be converted into sulphuric acid and remain in the ash in that form.

More careful studies of this part of the problem are necessary before any definite conclusion in regard to ash determination can be drawn.

In discussing the data it must be borne in mind that the results of a single season's experiments are not to be taken as final, but these results are interesting, and will show very clearly the variations which may be effected in a single year in the composition of the wheat.

Indeed, it is rather surprising to see that at the California experiment station, representing a State which formerly was supposed to be one in which the tendency of wheat was to lose its nitrogen content, there was in general an increase, not only in the total protein, but especially in the content of gluten therein. It appears that the meteorological conditions prevailing at Paso Robles are not similar to those which obtain in the principal wheat-growing areas of the Pacific Slope.

Effect of Season and Climate upon the Wheat Grain.

One of the principal seasonal influences affecting the composition of the wheat grain, and probably also of other cereals, is the length of period of growth. There appears to be a marked relation between the content of protein matter and starch and the length of the growing season. The shorter the period of growth and the cooler the climate the larger the content of protein and the smaller the content of starch, and vice versa. It is evident, therefore, that in countries where the period of growth is prolonged, as is the case in certain parts of the Pacific coast and in the southern part of the country, there would be a tendency to increase the amount of starch in the grain at the expense of the nitrogen; while in regions of short growth, such as Minnesota, the Dakotas, Colorado, and other Northern latitudes where the wheat is planted in the spring, there would be a tendency to increase the protein at the expense of the starch. There may be marked departures from this rule, however, as indicated by some of the data from California. A longer and more careful study will be required on this point.

The general deduction which can be made on the results of the experiments on which the above statements are made is to hasten the period of growth as much as possible where a high content of protein is desired. This leads to the suggestion that in regions where it is possible, the spring wheats should be cultivated rather than those which are planted in the autumn. Especially would this remark apply to irrigated areas where a rapid and uniform growth of the wheat could be secured, under proper conditions of moisture, until the period of approaching maturity was reached; then by withdrawal of the water, wholly or in part, the ripening would be accelerated.

Another seasonal influence affecting the composition of the grain is found in the fact that in southern countries the intense heat which is apt to occur about the time of the ripening of the grain hastens the process too rapidly, thus tending to diminish the valuable properties of the harvest.

While the control of the climate is a problem practically beyond the scope of agriculture, it is evident that by certain modifications of methods of cultivation, time of planting, irrigation, and fertilization, great advantages might be taken of natural climatic conditions which in the end would produce the same results as if the conditions themselves could be modified; and this is evidently true in the case of wheat, where the shortness of the time from the planting to the harvest, as is seen from the experiments already made, would tend to produce a high nitrogen content of the harvested crop. Since, as has already been remarked, this increase of nitrogenous matter makes the wheat, as a rule, more valuable, it is evident that great financial gains could be expected if such a consummation could be secured.

It is stated by Dehérain[1] that a high temperature during the month of July diminishes the yield of grain, especially in lowering the production of starch. He cites a season in which the summer had been, with a moderately low temperature, particularly rainy, and thus the ripening of wheat had been retarded. The harvest took place the middle of August and was the largest that had been obtained, up to that time, on the experimental fields at Grignon. The analysis of the wheat harvested showed that it contained 12.6 per cent of protein and 77.2 per cent of starch. The following season, on the contrary, the month of July was dry and hot. The ripening of the wheat was hastened and the harvest took place three weeks earlier than the previous season. The grain contained 15.3 per cent of protein and only 61.9 per cent of starch. The total quantity of protein in the two harvests was almost the same, by reason of the second harvest being less in quantity, but the quantity of starch produced per hectare was very much less than that produced the first season. Thus, it is evident that the elaboration of starch was arrested by the rapid desiccation of the plant. It is apparent, therefore, that this hot and dry time immediately preceding the harvest, while it may apparently increase the content of protein, does not really do so, except in the percentage found in the grain, while the effect of such seasonal influence upon the actual production of starch is to greatly diminish it.

[1] Director and chief chemist of the most important agricultural station of France, at Grignon, near Paris.

Influence of Environment upon the Composition of the Sugar Beet.

In the continuation of the study of the effect of environment upon the composition of the sugar beet, the Bureau of Chemistry was fortunate in securing the cooperation of the Weather Bureau and of a number of agricultural experiment stations. Those collaborating in the work are: Indiana, Iowa, Kentucky, Michigan, New York (Geneva and Ithaca), North Carolina, Utah, Virginia, and Wisconsin.

The plan of work is very similar to that outlined for the conduct of the experiments with wheat. Standard varieties of seeds are sent to the different stations, where they are subjected to as nearly as possible the same conditions of planting and cultivation. The meteorological data at the stations, or at the nearest weather station thereto, are carefully collected and summarized by the Weather Bureau. The soils in which the beets are grown are sampled and analyzed in the Bureau of Chemistry. When the period of maturity approaches, successive samples of beets are secured from the stations, and these samples are analyzed at the stations, and similar samples are sent on to the Bureau of Chemistry for a duplicate analysis. Experimental plats of the same variety of beets are also cultivated on the experimental farm of the Department of Agriculture on the island formed by the reclamation of the Potomac Flats adjoining Washington.

An illustration of the data secured is found in the following summary of the analyses of beets from the different stations for one year:

Summary of averages of analytical data of sugar beets.

Beets from—	Average weight.	Estimated yield per acre.	Sugar in the beet.	Coefficient of purity.
	Ounces.	*Tons.*	*Per cent.*	
Raleigh, N. C	12.4	1.3	5.2	....
Lexington, Ky.[a]	9.0	10.0	7.8	69.5
Washington, D. C	18.5	45.0	8.3	69.1
Lafayette, Ind	4.9	....	9.9	83.0
Ames, Iowa	13.0	....	11.7	76.9
Logan, Utah	....	18.9	12.1	84.2
Agricultural College, Mich	12.0	15.8	13.1	80.0
North Judson, Ind	15.2	....	13.7	89.5
Ithaca, N. Y	18.0	15.0	14.0	81.9
Madison, Wis.[b]	12.3	9.0	15.2	86.2
Geneva, N. Y.[c]	16.1	....	15.5	83.9

[a] Average of data obtained at Washington and at Lexington.
[b] Average of data for fertilized and unfertilized plats.
[c] Average of data obtained at Washington and at Geneva.

In the case of sugar beets, the evidence is of an overwhelming nature that the temperature of the growing season is by far the most

important factor in changing the content of sugar. But other meteorological factors are more or less potent in influencing the composition of the beet. In order to show the magnitude of these factors and their relation to the content of sugar in the beet, they have been graphically platted, as shown in the charts (figs. 27–29).

CONCLUSIONS AS TO SUGAR BEETS.

The conclusions which are deduced from a study of the preceding data and the graphic charts, based as they are upon the observations of a single year, will be subject to such correction as may be indicated by the results of subsequent studies.

DISCUSSION OF FACTORS INFLUENCING COMPOSITION OF SUGAR BEETS.

Latitude and sunshine (Chart No. 1).

On Chart No. 1 are platted the percentage of sugar in the beet, the latitude of the station, and the hours of sunshine. The curve representing the latitude and the curve representing the sugar in the beet are evidently more nearly related to each other than the curves representing any other data in any other one of the three charts given. It will be seen that there is a very close agreement between the latitude curve and the percentage of sugar curve. High sugar and high latitude run very evenly together. The actual hours of sunshine do not appear to have much influence upon the sugar content, or perhaps it would be better to say that the curves do not coincide even approximately.

It is evident that the elements of sunlight, which are active in promoting the action of the chlorophyll cells in the formation of sugar, do not depend solely upon the direct rays of the sun. The diffused light coming through the clouds is apparently almost as effective as the direct light. The highest percentage of sunshine found in any of the stations platted was at Lexington, Ky., reaching nearly 75 per cent of the possible hours of sunlight. The lowest percentage of direct sunshine was found at Agricultural College, Mich., being 59.2 per cent. Interesting data are also given in connection with the total sunshine by the shaded bars on the chart showing approximately the distribution of the sunshine in the various months, that is, the number of clear days. A clear day is one having on the average not more than three-tenths of the sky covered by clouds; a partly cloudy day is one having on the average from four-tenths to seven-tenths (inclusive) of the sky covered by clouds; and a cloudy day is one on which the sky is overcast, or at least eight-tenths covered by clouds. In order to show the complete relation, however, the bars must be taken in connection with the number of cloudy and partly cloudy days. A striking illustration of this is shown by the data at Lexington, Ky.,

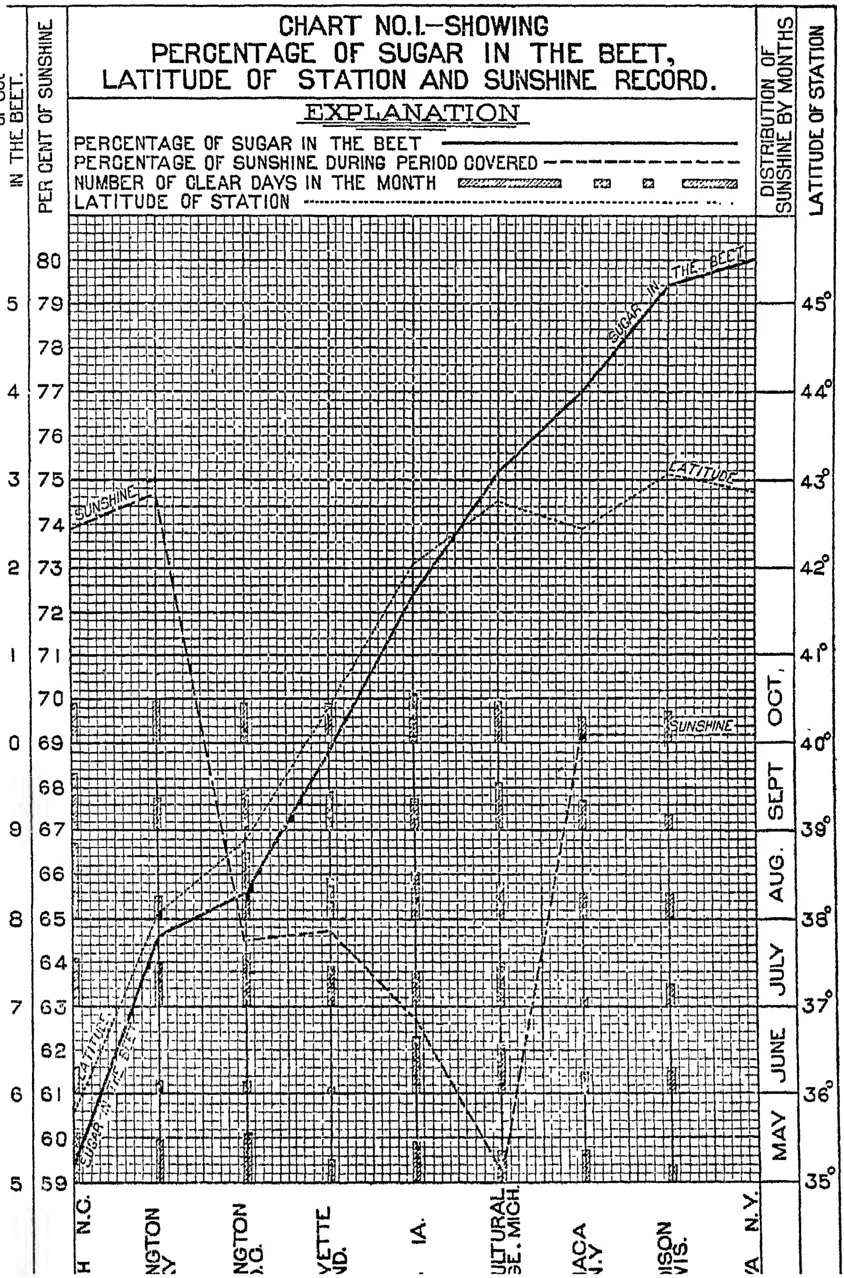

FIG. 27.—Percentage of sugar in beet, with latitude of station and sunshine record.

for June. During this month there were four clear days, and therefore the shaded bar for June in the Lexington column is very short. The number of cloudy days was only seven, and there were nineteen days partly cloudy. In the study of the chart, therefore, it is seen that Raleigh, N. C., and Washington, D. C., have the largest number of clear days, while Madison, Wis.; Ithaca, N. Y.; Lafayette, Ind., and Lexington, Ky., are types of stations where the number of clear days was relatively small. No record was made for the station at Geneva, but the data may be assumed to be practically the same as for Ithaca. The value of the shaded bars showing the distribution of sunshine is therefore less than if all the elements entering into the sunshine could be combined into a single curve.

Temperature and average length of day (Chart No. 2).

Chart No. 2 shows the curve for the sugar in the beet, the purity of the juice, the temperature, and the average length of the day. In this chart we have a remarkable illustration of the influence of high temperature upon sugar content. The two curves make almost an X-shaped figure. Low sugar and high temperature evidently go together. The highest temperature record for the summer was at Raleigh, N. C., and the lowest at Agricultural College, Mich. The temperature curve could also be very profitably compared with the latitude curve on Chart No. 1. It would form, also, an X-like figure with that curve.

Though there are many variations from this rule, it is shown in general, however, that the higher the percentage of sugar the higher the purity.

The curve showing the average length of the day from sunrise to sunset has a direct relation also to the content of sugar in the beet. The shorter the day the lower the content of sugar, and the longer the day the higher the content of sugar. This variation is doubtless partly due to the longer action of the sun's rays either directly or diffused through the clouds upon the sugar-producing cells of the leaf.

Altitude and rainfall (Chart No. 3).

In Chart No. 3 are platted the curves showing the percentage of sugar in the beet, the total rainfall, the distribution of rainfall by months, and the altitude of the station above the sea level. The general influence of altitude, as is well known, is to lower the temperature for a given latitude. In other words, the altitude to a certain extent becomes a function of the latitude curve, and it would probably be advisable in some way to combine the two into a single curve. The highest altitude of the experimental stations collaborating (exclusive of Logan, Utah, which is not included in the charts) is at Lexington, Ky., namely, 979 feet; the lowest (sea level) at Washington. Other notably high stations are at Ames, Iowa, and Madison, Wis., and other notably low stations are at Raleigh, N. C., and Geneva, N. Y.

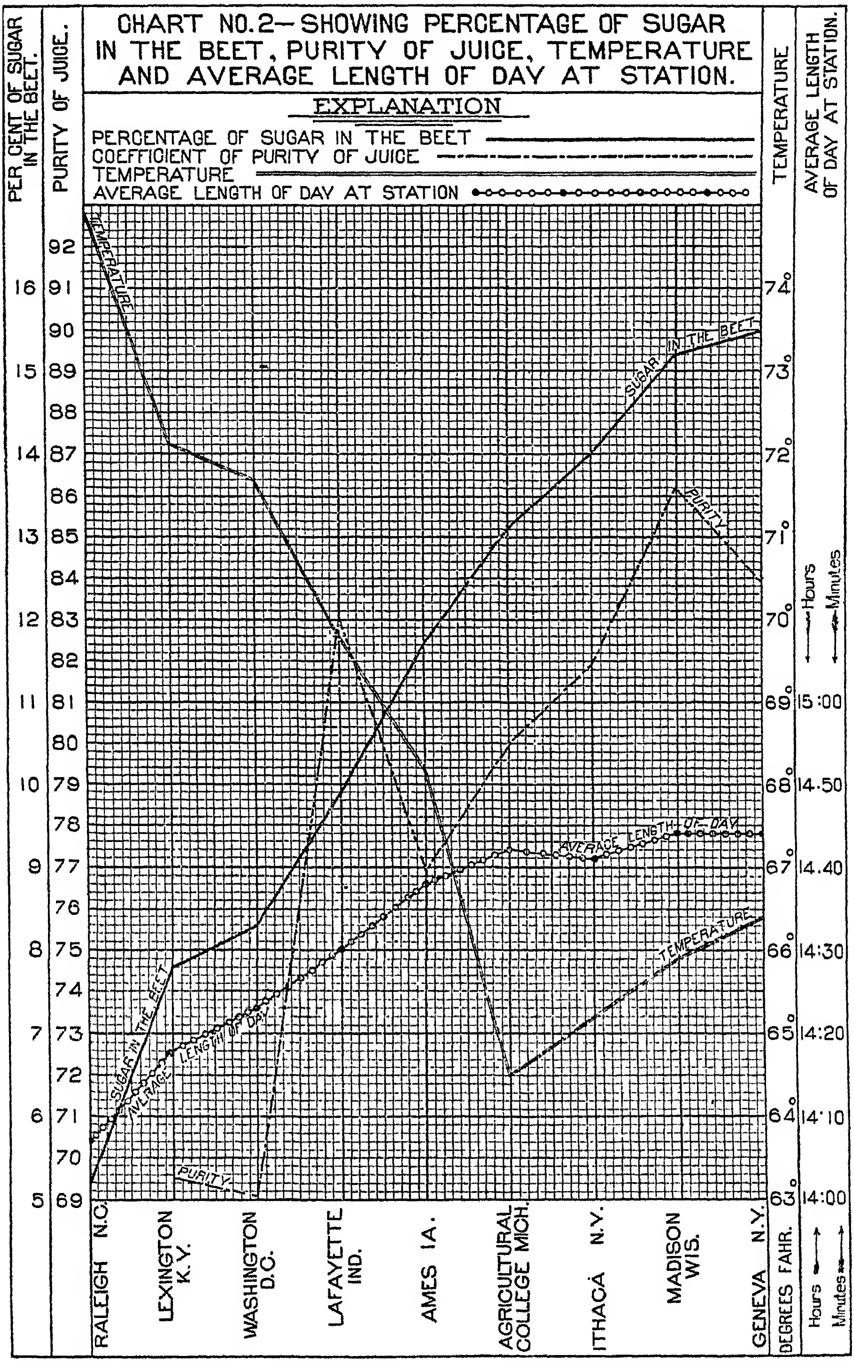

FIG. 28.—Percentage of sugar in beet and purity of juice, with temperature and average length of day at station.

A more important relation to sugar content is shown by the rainfall, especially in its distribution. The total amount of rainfall, it is evident, has less influence on the sugar content than its even distribution during the growing months, provided the rainfall is sufficient for the growing crop. The greatest rainfall shown at any of the stations was at Ames, Iowa, and the lowest at Ithaca, N. Y. The rain at Ames was evidently far in excess of the requirements of the growing crop. The Washington rainfall was quite sufficient in quantity, but it was extremely uneven in distribution. For instance, during the month of June about 11 inches of water fell in Washington, while in July and August, when water was most needed, the amount was only about 1 and 2 inches, respectively. A very even distribution of rainfall is shown in the station at Geneva, N. Y., while the quantity was relatively small. The distribution of the rainfall, also, at Ithaca was somewhat even, but there was a slight excess in October at a time when it would be injurious to the beet in the way of inducing a second growth. On the other hand, the September rainfall at Ithaca was small, thus favoring the ripening of the beet. The ideal conditions for the growth of the beet are an even distribution of the rainfall of from 3 to 4 inches during the months of May, June, July, and August, and a reduction of the rainfall for September and October.

The above conclusions, derived from these studies of a year, are quite in harmony with the theories which already prevail in regard to the effect of seasonal influences upon the sugar content of the beet. There are many problems, however, represented by the data which offer an inviting field of study. Chief among these is the suggestion that the high temperature which seems to be so disastrous in its effects upon the sugar content of the beet may not produce all these ill effects directly, but to a certain extent indirectly in its effect upon the moisture in the soil, the arrest of growth by dry weather, the inducement of a second growth on the accession of rains following a drought, and in other ways. The study of this problem could best be carried on in an irrigated arid region where the temperature is high during the growing months, and where the distribution of water on an experimental plat could be absolutely controlled. Other new problems of interest are also presented in studying the effects of direct and indirect sunshine and the distribution of the hours of direct sunshine compared with indirect and with partly cloudy weather.

DATA REGARDING SUGAR BEETS FROM THE EXPERIMENT STATIONS.

The influence of some other factors on the environment are also brought out in the data which have been obtained, notably the effect of fertilizers. This is shown particularly in the data from the Wisconsin experiment station. These data will also serve as a type of the information which is secured from each of the collaborating agricultural experiment stations in this work.

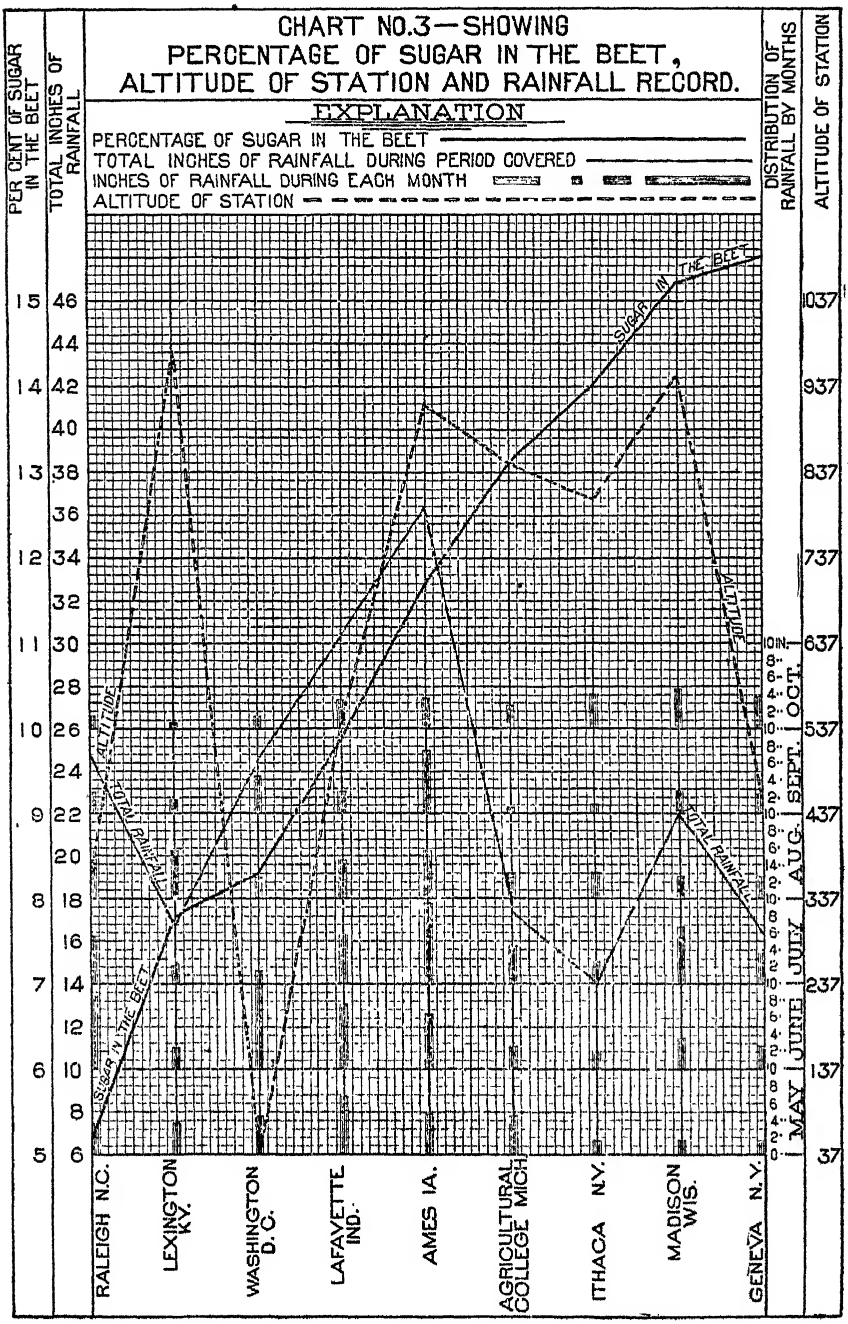

FIG. 29.—Percentage of sugar in beet, with altitude of station and rainfall record.

WISCONSIN.

WEATHER.—The meteorological data for Madison, Wis., are as follows:

Meteorological data for Madison, Wis., from May to October, 1900.

Month.	Mean temperature.	Precipitation.	Clear days.	Cloudy days.
	Degrees.	*Inches.*		
May	60.6	1.86	6	14
June	67.7	3.20	9	7
July	70.2	6.91	8	14
For three months	66.2	11.97	23	35
August	75.2	2.72	9	10
September	63.6	2.89	6	12
October	58.0	4.43	10	14
For three months	65.6	10.04	25	36
For six months	65.9	22.01	48	71

FERTILIZERS.—The influence of fertilizers on the yield of beets and the composition thereof is shown in the following table:

Austrian Special Kleinwanzlebener beets grown and analyzed at the Wisconsin experiment station, Madison, Wis.

Items.	Fertilized beets.	Unfertilized beets.
Average weight ... pounds	0.81	0.73
Shrinkage[a] ... per cent	18.98	19.07
Specific gravity	1.0779	1.0753
Sugar in the juice ... per cent	16.66	15.28
Purity	88.53	83.93
Sugar in the beet ... per cent	15.81	14.52
Total yield:		
Total weight ... pounds	841.6	542.9
Weight, less shrinkage ... do	681.9	439.4
Sugar ... do	107.6	63.81

[a] The shrinkage refers to that part of the beet lost in washing and crowning.

Results calculated to the acre for Austrian Special Kleinwanzlebener beets grown

	Fertilized beets.	Unfertilized beets.
	Tons.	*Tons.*
Total weight	10.91	7.04
Weight, less shrinkage	8.84	5.7
Sugar	1.398	0.83

It is interesting to note the influence of the fertilizer employed. The fertilized sections of the plat yielded almost 4 tons more per acre than

the unfertilized, while the percentage of sugar in the fertilized portion was considerably higher than in the unfertilized. Since it would not be quite fair to select either the fertilized or the unfertilized data for purposes of comparison, it has been determined to take the mean of the two as representing the proper data for the comparative work.

NEW YORK.

Barnyard manure.—Another important influence of environment has been brought out by the researches of the New York experiment station at Geneva. It is the common impression among European investigators that the application of barnyard manure, as a rule, has an injurious effect upon the content of sugar in the beet. Director Jordan says in relation to this matter:

> For three years we have been making an effort to compare the effect of commercial fertilizers with that of farm manures upon the composition of sugar beets. In all of these years the percentage of sugar and the coefficient of purity with the beets raised on the farm manure have been of a high standard, the percentage of sugar in two years being higher than where the beets received commercial fertilizers. The other year the percentage of sugar was higher in the beets fertilized with farm manure than where no farm manure at all was used. The amount of manure per acre was 40,000 pounds, or about 10 cords. It was manure from the cow stable which had been somewhat fermented but not very fully. In other years we have used fresh manure. I am inclined to think that we have all the time been placing altogether too much confidence in German results as applied to American conditions.

INFLUENCE OF ENVIRONMENT ON SUGAR BEETS IN IRRIGATED AREAS.

The influence of environment in irrigated areas has been so little studied that it would not be safe, at the present time, to draw any definite conclusions respecting the data. The development of the arid regions of the country shows the possibility of the production of beets of high tonnage and excellent quality, and the problem of environment here is entirely different from that which is under investigation for the areas of average rainfall. Any deductions, therefore, respecting the data obtained in irrigated areas would be of little or no value, based upon the study of a single season. It may be suggested that one of the principal factors which is operative in diminishing the sugar content of beets grown in warmer climates relates to the water supply rather than to the temperature itself. The beet in its natural state is an annual plant and only became biennial when carried to a higher latitude. Any diminution of moisture, coupled with a high temperature, therefore, tends to force the beet to an early maturity, and probably one reason of the low content of sugar of the beets grown in more southern climates is due to the forcing of the ripening process, thus interfering with the storage of the sugar in the beet by using it all in an effort to complete the vital functions. If this be the case, it appears that it would be possible to grow beets in irrigated

areas, where the temperature is quite high, by the regular and judicious supply of moisture, enabling the beet to complete the first part of its growth, viz, the storage of sugar, without interruption. Then by withdrawal of the water at the harvesting of the beets the sugar thus stored could be utilized for manufacturing purposes.

This is one of the problems of environment which will engage the immediate attention of the Bureau of Chemistry in the further study of the subject. If the theory above outlined should prove correct, it would permit the profitable growing of beets in the hotter portions of the arid regions wherever irrigation could be practiced. This would be especially true of the interior valleys of California, where the temperature, during the summer, is exceptionally high, and which, up to the present time, have developed no special aptitude for the growth of sugar beets of high quality. The beet-sugar industry of California has hitherto been confined to the coast valleys, where the mitigating influences of the ocean breezes keep the summer temperatures low. With a higher temperature a more rapid ripening of the crop would be secured, and it seems reasonable to suppose that under irrigation, in warmer climates, a beet crop might be ready for the factory within three or four months from the date of planting instead of the five or six months required under the conditions in which beets have usually been grown. The same remarks may also be applied with equal pertinency to other areas, such as Kansas, where hot and dry summers have prevented the production of beets in quantity and quality to meet the requirements of competition. Especially in western Kansas the practice of irrigation bids fair to secure crops of beets of high quality.

It is thus evident that in the scientific study of the effects of environment upon the composition of the beet, new avenues of practical importance may be opened to agricultural work and the areas suited to beet culture may be largely extended.

The same methods of investigation may also be applied with profit to other crops, both of the field and garden.

ROAD BUILDING WITH CONVICT LABOR IN THE SOUTHERN STATES.

By J. A. Holmes,
Special Agent in Office of Public Road Inquiries for Southern Division.

INTRODUCTION.

The principle which obtains in the punishment of the criminal is the prevention of crime, both by reforming or permanently confining him and by deterring others from following his bad example. In the accomplishment of this purpose it has come to be generally admitted that during the infliction of punishment the physical health of the prisoner should not be impaired; and that everything possible should be done looking to such improvement of his character as may fit him for better citizenship.

EMPLOYMENT OF CONVICT FOR BENEFIT OF COMMUNITY INJURED.

Another principle, in no sense out of harmony with the first, and which, in this connection, is worthy of more general acceptance, is that the prisoner who has injured a community through the commission of crime, and whose capture, conviction, and punishment have added to its financial burden, should, if possible, in connection with his punishment, do something to benefit the community which he has injured. The correctness of this principle is coming to be widely accepted in the Southern States, where the belief prevails that perhaps the best way in which a criminal can benefit the community he has injured is in helping to improve its public highways. And in doing this work without compensation and at a cost actually less, in many cases, than that of his keep in the county jail, he is benefiting his community without imposing on it an additional tax burden; he is not in the ordinary sense competing with hired labor, and he is doing work which hired labor does not care to do unless paid such wages as will prove a too serious drain on the public treasury.

This method of employing convict labor in a majority of the Southern States may be fairly said to have passed the experimental stage, and to have become a part of the accepted practice.

SOUTHERN STATES EMPLOYING CONVICT LABOR ON ROADS.

The following table illustrates the extent to which this method of employing convict labor has already been adopted in a number of the Southern States:

Details of employment of convict labor on roads in the Southern States.

State.	Number of counties in the State.	Counties reporting.	Counties using convicts on public roads.	Average number of convicts employed on public roads during 1900.	Average cost of guarding and maintenance per convict per day on the roads.	Average cost per prisoner per day for keeping in county jails.	Number of prisoners usually kept in county jails, and not employed on roads.	Average cost of hired road labor per day.	Yearly value of labor of convicts employed on public roads during 1900.[a]	Yearly value of labor of prisoners usually kept in county jails, and not employed on roads.
Alabama	66	66	2	25	[b]$0.81	$0.30	789	$0.90	$6,187	$195,387
Arkansas	75	70	21	62	[b].85	.75	320	.95	16,197	83,600
Florida	45	44	11	106	.46	.40	437	.92	26,818	110,561
Georgia	137	129	27	946	.26	.35	1,073	.60	156,080	177,045
Kentucky	119	109	42	419	.52	.50	583	1.00	115,225	160,325
Louisiana	59	57	9	67	.50	.40	337	1.00	18,425	92,675
Mississippi	75	74	12	113	.25	.30	397	.60	18,645	65,405
North Carolina	97	97	24	643	.24	.30	607	.75	133,508	125,193
South Carolina	40	36	32	579	.18	.30	404	.75	119,418	83,325
Tennessee	96	88	37	722	.26	.40	888	.80	158,740	195,360
Texas	229	214	65	672	.30	.45	1,197	1.15	211,520	378,551
Virginia	100	95	5	23	.38	.30	329	.80	5,060	72,380
Total or average	1,138	1,079	287	4,377	[b]0.33½	[c]0.35	[d]7,361	.85	985,823	1,739,807

[a] In estimating the value of this convict labor the per diem paid ordinary laborers in the respective States as shown in the column giving the average cost of hired road labor per day is taken as a basis; and it is assumed that 275 work days may be reasonably counted upon for these States.

[b] In determining this average the figures for Alabama and Arkansas were omitted, owing to the probability that certain expenses connected with the maintenance of the teams have been, by mistake, included in the figures reported from these States.

[c] In determining this average the figures for Arkansas have been omitted as being abnormally high.

[d] Concerning this total number of prisoners in the county jails of these 12 Southern States, it should be stated that an unknown proportion, probably in some States at least 50 per cent, of these are persons awaiting trial and unable to give bond. This situation may continue for from a few days to several months. The remainder of these prisoners have already been tried and convicted, but remain in jail idle, at the expense of the county, for the reason that no employment is provided for them.

As will be seen from the table, the use of convict labor in public-road building is most largely practiced in the States of Georgia, Tennessee, Texas, North Carolina, South Carolina, and Kentucky, in the order named. In Virginia, where only twenty-three convicts are reported as having been used on the public roads of the State, and these confined to four counties, and in Alabama, where only twenty-five convicts are reported as being used on the public roads in two counties, the system is still in its infancy. In Arkansas, Florida, Louisiana, and Mississippi the system has been more largely adopted, but in these States only short-term convicts are used, and in most of

the counties the number so employed is small; consequently the per capita expense is large, which is also the case in Alabama. Hence, even in these States, the custom has not yet been established on a satisfactory basis.

CLASSES OF CONVICTS EMPLOYED ON THE PUBLIC ROADS.

Laws of the different States on this subject usually specify that only able-bodied male convicts sentenced for short terms are to be assigned to work on the public roads. In the States of Virginia, West Virginia, Kentucky, Tennessee, Louisiana, Mississippi, Texas, Florida, and Georgia prisoners convicted of misdemeanors only may be assigned to work on the public roads, and for these the sentence does not usually exceed one year, which, when the costs are added, may be thereby extended to nearly two years in extreme cases. In Alabama, in a few cases, all able-bodied male prisoners whose terms of sentence do not exceed two years may be assigned to work on the public roads. In South Carolina this limit is extended to five years, and in North Carolina to ten years.

The experience in North Carolina during the past ten years has shown that all the able-bodied male prisoners whose terms of sentence do not exceed ten years may be successfully employed at the ordinary work of highway improvement. Many such prisoners in different Southern States whose terms of sentence range between one and ten years are now employed under either the lease or contract system, or under State control, and are working on farms or in mines and factories. All of these might be employed in improving the public highways. The expense entailed would not be great; the difficulties which seem to stand in the way would disappear in practice, and the result would be of incalculable benefit in helping along industrial and educational development in each of these States.

The experience in California has shown also that even the longer-term convicts can be employed to great advantage by the State in quarrying and crushing stone at one or more central points for use in permanent road building. Stone is being extensively crushed in this way in California at less than half what it costs to do this work with hired labor in other States. The quarries used for this purpose are surrounded by a strong stockade, which also incloses the convict quarters, and the escape of prisoners under such conditions is not greater than that from the State prisons. Such a system is applicable, and could be adopted to advantage in each of the Southern States, except in Mississippi, Louisiana, and perhaps Florida.

The captured, but as yet unconvicted, prisoners who are unable to give bail often constitute a considerable portion of the inmates of Southern county jails, such as are shown in the seventh column of the table on page 320. Under judicious management and an arrangement

involving the mutual consent on the part of the prisoner and the county authorities this additional class of prisoners will be found, in large measure, available for highway improvement. This arrangement should provide in each case that when the court's judgment is finally passed, if the prisoner be acquitted, he is to be paid by the authorities a fair compensation for his services already rendered; or if he be convicted, in the carrying out of the sentence of the court the time during which he has already rendered service shall be credited to his account. Under this plan, which has not as yet passed beyond the experimental stage, the acquitted prisoner is set free in possession of a small capital for his support while seeking honorable employment; on the other hand, the prisoner who, for example, five months after his capture, is convicted and sentenced "to the roads" for a period of one year, has, at the time of his sentence already served his county usefully for five months. His sentence will now require of him only seven months additional service before he is set free.

THE NORTH CAROLINA LAW GOVERNING THE EMPLOYMENT OF PRISONERS ON ROADS.

The North Carolina law of 1901, controlling the assignment of convicts for public-road building purposes, is perhaps the most sweeping to be found in any of the Southern States, and may be quoted as follows:

SEC. 8. That all prisoners confined in the county jail, under a final sentence of the court for crime, or imprisoned for nonpayment of costs or fines, or under final judgment in cases of bastardy, or under the vagrant acts, all insolvents who shall be imprisoned by any court in said county for nonpayment of costs, and all persons who would otherwise be sentenced in said county to the State prison for a term of less than ten years, shall be worked on the public roads of the county: *Provided*, That in case the number of such persons in any county, at any time, be less than ten, the commissioners of the county may arrange with the commissioners of any neighboring county or counties for such exchange of prisoners, during alternate months or years, as will enable each such cooperating county to thereby increase the number of prisoners at work on the public roads at any given time. And upon application of the said road superintendent of the county, or that of the chairman of the board of county commissioners, the judge of the superior court, or the judge of the criminal court, the justices of the peace and the principal officer of any municipal or any other inferior court, it shall be the duty of the said judge or justice of the peace, or said principal officer, to assign such persons convicted in his court to said road superintendent or road supervisor in any township making provision for the same, for work on the public roads of said county or township; all such convicts to be fed, clothed, and otherwise cared for at the expense of the county or township, as the case may be: *Provided further*, That in case of serious physical disability, certified by the county physician, persons convicted in said superior, criminal, or inferior court may be sentenced to the penitentiary or the county jail.

SEC. 9. That when the commissioners of any county shall have made provisions for the expense of supporting and guarding, while at work on the public roads of the county, or any township thereof, a larger number of prisoners than can be supplied

FIG. 1.—PORTABLE CONVICT QUARTERS ON WHEELS, USED FOR THE CONVICT FORCE WORKING ON THE PUBLIC ROADS IN DAVIDSON COUNTY (ABOUT NASHVILLE), TENN.

[This arrangement is applicable when a small number of convicts are employed.]

FIG. 2.—SLEEPING QUARTERS FOR CONVICTS USED ON THE PUBLIC ROADS IN MECKLENBURG COUNTY, N. C.

[This house accomodates 50 persons. Its sides and ends are of boards bolted together in sections. The roof, of corrugated iron, is also in sections, so that the structure can be easily taken down, transported, and set up again. It can also be lengthened or shortened according to number of prisoners to be accommodated.]

from that county, upon application of the commissioners of said county to the judges of the superior and criminal courts, the justices of the peace and the principal officers of any municipal or other inferior court presiding in any other county or counties which do not otherwise provide for the working of their own convicts upon their own public roads, shall sentence such able-bodied male prisoners as are described in section 8 of this act from such other counties to work on the public roads of said county or townships applying for the same, in the order of their application; and the cost of transporting, guarding, and maintaining such prisoners as may be sent to any such county or township applying for the same shall be paid by the county or township applying for and receiving them out of the road fund of each such county or township: *Provided*, That any and all such prisoners from such other counties may at any time be returned to the keeper of the common jail of such counties, at the expense of the county or township having received and used them.

MANAGEMENT OF THE CONVICT ROAD FORCE.

As a rule, it has not been found economical to work convicts on the public roads when the squad consisted of less than eight or ten men. It is customary to have one guard for each ten or fifteen men, and, of course, this one guard would be necessary even were there only one or two men in the squad. In addition to the guards, there is usually a superintendent of the work; consequently this work is carried on most efficiently when the road force or camp contains from thirty to fifty men. When the number of convicts to be employed on the roads in any county is more than fifty or sixty, it has been found better to divide the force into two squads or camps, each having its own local superintendent and guards, and both squads managed under the general supervision of the county superintendent of roads, he in turn being responsible to the county court or board of county commissioners.

It is usually urged against this system of road building that it offers too many opportunities for the escape of prisoners. Experience in many counties, however, has shown that the average annual escapes amount to less than 2 per cent, and the few who do escape are usually recaptured within a day or two. Often the prisoners assigned to the roads are men who live in the community and have families and some property there, and consequently do not care to leave permanently; hence they rarely attempt to escape. Such prisoners as show a desire to escape, or who, in the judgment of the superintendent, are men liable to make an effort in that direction, are usually required to carry a ball and chain, which, while it makes it impossible for the prisoner to run rapidly, does not seriously hamper his movements in the regular road work. On the other hand, the convict who does his work faithfully and shows himself worthy is often rewarded by receiving generous treatment.

Morning and evening the prisoners are marched along the road from and to their temporary quarters, which consist usually of either heavy, large tents, portable houses on wheels (Pl. XXVII, fig. 1),

or structures either of wood or corrugated iron, built in sections so they can be easily taken to pieces, removed, and set up again (Pl. XXVII, fig. 2). In order to facilitate their being safely guarded during the night without too great risk and expense, each prisoner, when he goes to bed, has either one foot or one hand fastened loosely to a chain or rod, from which he can be easily released the following morning. The beds or bunks for these prisoners are easily and cheaply made comfortable, and the comfort of their temporary quarters is improved during the summer by ample ventilation and during the winter by the use of stoves.

The cooking and washing at the camps is usually done by some trusty male convicts, especially experienced in these directions, or by the female prisoners, or in still other cases by hired labor. The carrying of water, along with other similar errands, is usually assigned to the younger prisoners, or such as may not be sufficiently strong for the regular work on the roads. Isolated jobs are usually assigned to certain prisoners who, from their associations and generally good characters, are considered safe for carrying on such work without the immediate supervision of guards, and such prisoners are commonly known as the "trusties" of the camp.

The work of road building is usually extended to a distance of 1 or 1½ miles in each direction from the camp, and the camp is then moved a sufficient distance, so that 2 or 3 miles of additional road may be built before a second removal becomes necessary. The work done by these convict road builders includes almost every variety of manual labor necessary in this connection (Pls. XXVIII and XXIX). Thus, in counties like Mecklenburg, N. C., where considerable efficiency has been reached in macadamizing, they drive the teams, handle the shovels and picks, ride the road machines, quarry stone, run the engines, and operate the stone crushers (Pl. XXVIII, fig. 2), and occasionally the great steam rollers. They spread the gravel or broken stone (Pl. XXIX, fig. 1), and in still other counties they mix the sand and gravel or clay, and give shape to the road surface (Pl. XXXI).

EFFICIENCY AND COST OF CONVICT ROAD LABOR.

The cost of convict labor in road building, as might be expected, varies greatly with the efficiency or inefficiency of the management and the number of prisoners employed in any squad. The cost per convict per day in this work, including the cost of his food, tobacco, clothing, washing, medical attendance, and guarding, as reported for the year 1900 from representative counties in each of the several Southern States, is given on the next page.

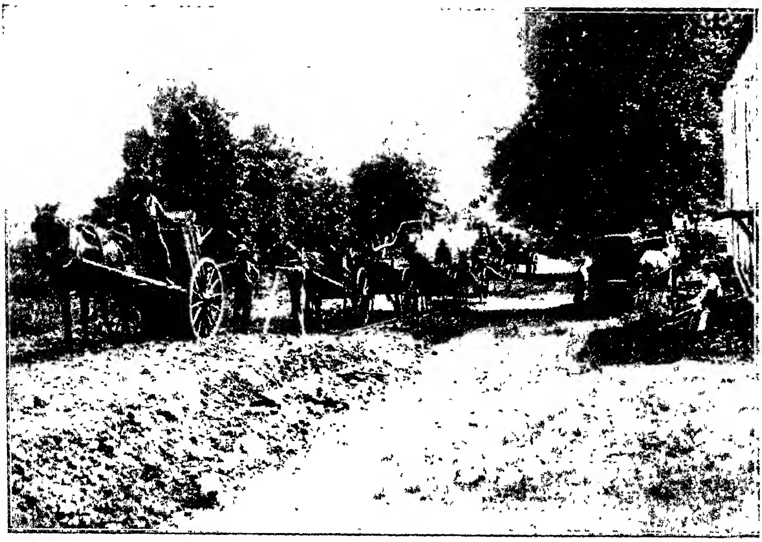

FIG. 1.—CONVICTS GRADING A PUBLIC ROAD IN SHELBY COUNTY, TENN., ABOUT 15 MILES NORTHEAST OF MEMPHIS.

[The soil cut from the top of the hill is brought by the dump carts to the flat below, where it is being used in making a fill 4 feet high.]

FIG. 2.—CONVICTS OPERATING THE ENGINE AND STONE CRUSHER, USED IN ROAD

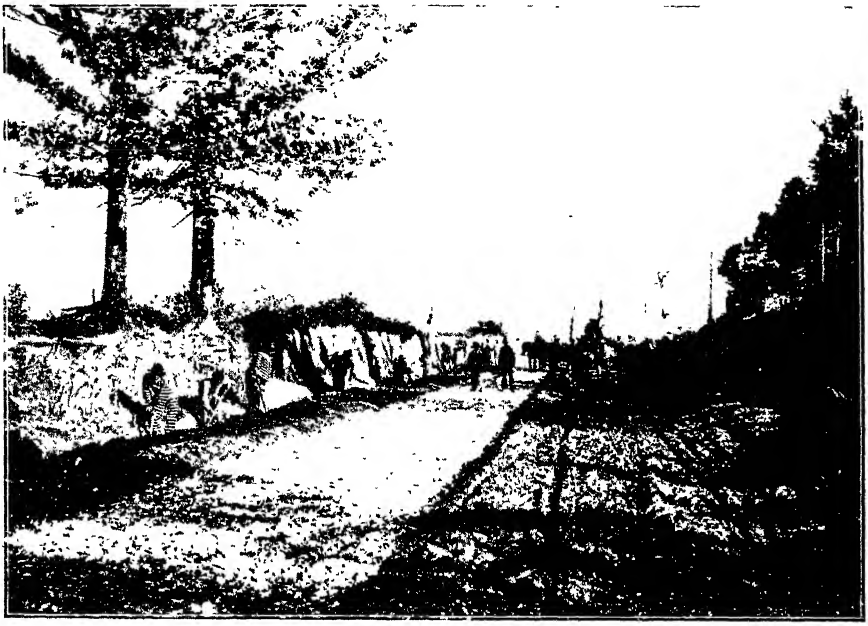

FIG. 1.—CONVICTS BUILDING A MACADAM ROAD IN MECKLENBURG COUNTY, N. C.

FIG. 2.—DOUBLE TRACK MACADAM AND EARTH ROAD, BUILT BY CONVICT LABOR IN MECKLENBURG COUNTY, N. C.

Cost of labor per convict per day in road work.[1]

	Cost per day.
Florida	$0.30 to $0.50
Georgia	.16 to .32
Kentucky	.50 to .60
Louisiana	.50 to .60
Mississippi	.15 to .45
North Carolina	.15 to .40
South Carolina	.17 to .22
Tennessee	.20 to .40
Texas	.20 to .40
Virginia	.25 to .50

A comparison of the figures given with similar figures for hired labor shows that the cost of convict labor in several States ranges from one-third to one-half that of the hired labor employed on the public roads in those States. In the two Carolinas and Georgia, where the road work is carried on with great efficiency, the cost of maintaining and guarding the convicts at work on the public roads ranges in many counties from 20 to 30 cents per convict per day, and is even considerably less than the cost of feeding them in the county jail. In explanation of this fact, it may be said that during the stay of convicts in the county jail the jailor is paid so much per day for feeding and caring for each; but that while they are employed on the public roads provisions are purchased at wholesale and competitive rates; that the convicts do their own cooking and washing; and that, owing to the usually healthy condition of the convict camps, the cost of medical attendance is almost nothing.

As to the efficiency of convict labor on the public roads, compared with that of ordinary labor, the general testimony from the many counties in the Southern States is highly in its favor. It must be borne in mind in this connection, however, that the hired labor which can be secured in the Southern States for work on the public roads does not belong to the most efficient class, and also that it can not be easily held longer than a few days or a few weeks at a time; consequently, it is often unsatisfactory. In the case of convict labor, on the other hand, the labor is entirely under the control of the guard and superintendent, and, especially in the case of long-term prisoners, it can be managed so as to reach a considerable degree of efficiency, both in ordinary work and in the handling of road-building machinery. Convicts thus not only make fairly efficient laborers while engaged in this work, but receive that training and experience which enable them to earn a better living, and hence become better citizens after the expiration of their terms of service.

[1] The figures for Alabama and Arkansas are omitted, owing to the probability that certain expenses connected with the maintenance of the teams have been, by mistake, included in the figures reported from these States.

It has been, therefore, the general verdict from the various counties in the Southern States where convict labor is employed in road building to any considerable extent, that in both efficiency and cheapness it is decidedly superior to such free labor as is ordinarily available there for this work.

INFLUENCE OF ROAD WORK ON THE CHARACTER OF THE CONVICT.

It is often urged against this mode of employing convict labor, that the very publicity of the work in exposing the prisoner to the view and to the remarks of the travelers along the highway would have a tendency to harden the criminal and make him less amenable to other beneficent influences. But careful inquiry concerning this point, made in many counties, has failed to elicit evidence in favor of this supposition. On the other hand, a considerable amount of evidence has been collected which goes to show that this out-of-door work not only improves the physical health of the convicts, but that their experiences as road builders have actually improved their general character and prepared them for better citizenship. Moreover, there are in these different States hundreds of cases where prisoners connected with the road camps have behaved themselves properly and labored efficiently, have been trained and trusted by their superiors, and have secured at the expiration of their terms of sentence fair positions in or near the communities where they had previously lived.

It is, of course, as true of convicts as it is of other persons, that fair and just treatment by superiors tends to develop the better qualities, whereas harsh and unfair treatment tends to develop the meaner side of their nature, and the latter treatment should never be permitted. As a rule, the treatment of the prisoners at the various road camps in the Southern States is fairly humane, though there is need of improvement along this line. Religious services are usually provided for them on Sundays, and an earnest effort is made to develop these convicts into better men as well as more efficient laborers. There are, of course, some exceptions to this, and it should be the constant purpose on the part of those in authority to see that these exceptions disappear. While a convict must be punished as he deserves, he must also always be treated with that uniform kindness and fairness which lead him, even as a prisoner, to realize that justice prevails, and that it pays to do right.

Every effort should be made by the proper authorities to educate a prisoner to a realization of his indebtedness to society (especially to some particular community) and the justness of his punishment. The acknowledgment and fulfillment of this obligation on the part of a criminal should be as helpful to his character as is the payment of an honest debt helpful to the character of an ordinary citizen. The circumvention of justice has an injurious influence as well in the one case as in the other.

EXAMPLES OF ROAD BUILDING BY CONVICT LABOR.

The nature and extent of the work done by convict labor in the improvement of highways in the Southern States can be best illustrated by a brief statement of what has been accomplished in a few counties selected out of a large number that have adopted this system.

GRAVEL ROADS AND SAND-CLAY ROADS IN RICHMOND COUNTY, GEORGIA.

Prior to the year 1879 the public roads of Richmond County, Ga., were in a state of neglect. Over a portion of them the surface was a deep sand, the dread of all travelers during dry weather, while the surface of the other portion was of clay, which became a quagmire during the rainy season. Meanwhile the authorities were at a loss to know what to do with their county prisoners, and the lack of a definite policy in this regard resulted either in keeping all the prisoners in the county jail, at considerable expense, or else employing them at miscellaneous jobs about the city of Augusta, the county seat. In January, 1879, the county judge inaugurated a definite policy for the improvement of the public highways of the county, and placed every available county prisoner at work with a view to the accomplishment of this end.

The work of improving and keeping in repair 350 miles of public roads and 3 miles of bridges was begun with a force of thirty prisoners and ten mules, and with funds but little more than sufficient to maintain this force upon an economical basis. Fortunately, the work has been pushed continuously to the present date. While naturally these efforts at first met with considerable opposition, the results have proved so eminently satisfactory to the people of the entire county that to-day the system meets with practically unanimous support.

The first work undertaken was the grading and draining of the roads. This was followed by the spreading of a few inches of sand over the clay roads and a few inches of clay over the sandy roads, the cost of this work being but little more than the expense of the labor and hauling, as the material was usually found close at hand. For the country roads where the traffic was light, the surface prepared in this way proved eminently satisfactory, often requiring little or no repairing for several years. On the main thoroughfares, nearer the city, where the traffic was heavier, the sand-clay surface proved less satisfactory, and it was found advisable to spread a layer of gravel on top of it. These roads have a width of 30 feet, and the gravel has been spread over the center to a depth of from 6 to 8 inches, for a width of 20 feet near the city and 16 feet farther out in the county. On the sand-clay roads in the one case the sand is spread over the clay surface to a depth of 2 to 6 inches; in the other case the clay is spread over the sandy surfaces to a similar depth. The cost of the gravel roads has averaged about $1,600 per mile, while that of the sand-clay roads has ranged from

$100 to $500 per mile, this variation being due to the amount of grading to be done and the nature of the materials used, and the distance it was necessary to haul them. The force at work on these roads at the present time consists of one hundred convicts, thirty-two head of stock, and a thorough equipment of machinery.

As a result of this well-directed policy, there are now in Richmond County 100 miles of sand-clay roads and 100 miles of gravel roads, all well graded and drained (Pl. XXX, fig. 1). The old wooden culverts have been replaced by larger ones of brick and smaller ones of vitrified pipe, and the old wooden bridges are being replaced by more modern structures of iron and steel. This accomplishment is the result of a well-directed continuous policy inaugurated and pushed by an intelligent, determined public official, whose efforts have deservedly won and now continuously receive the support of an intelligent public opinion.

THE SAND-CLAY ROADS IN RICHLAND COUNTY, SOUTH CAROLINA.

The sand-clay roads in Richland County, S. C., are worthy of special consideration, not only as a product of convict labor, but also as an illustration of how much may be accomplished in many localities in highway improvement at small cost, by treating the road surface with a simple admixture of sand and clay. This county, with Columbia as its county seat, is located where the hill country merges into the lowlands, and where the beds of coarse sand and clay are in close proximity. After constructing 2½ miles of ordinary macadam road, at a cost of from $2,000 to $3,000 per mile, the county supervisor (who in all South Carolina counties has charge of the public roads) wisely decided to try the simpler and cheaper plan of spreading sand over the clay roads and clay over the deep sandy roads (Pl. XXXI, fig. 1.), and he has carried forward this work to an extent and a degree of efficiency perhaps equaled nowhere else in the neighboring States. It was not easy to determine the amount of sand in the one case, or of clay in the other, which would give the best final result. Consequently, it has been necessary to watch the resulting road surface for several months, in some cases adding more sand where the surfaces showed a tendency to give way under traffic in wet weather, or in other cases adding more clay where the tendency was for the surface to break up during the dry season. First, the roads were cut to a grade of from 2 to 3 per cent, then the surface was given the proper cross section for shedding water, this surface slope being kept sufficiently gentle to permit the water to run off slowly and not to carry the sand with it. The clay or sand was then hauled in wagons or carts, usually short distances, and spread over this surface for a thickness of from 2 to 6 inches. The mixing of the sand and clay was done by the ordinary travel, which was never stopped, and the surface was finally packed by the wide-tire wagons and carts or a horse roller. Where the supply of sand needed

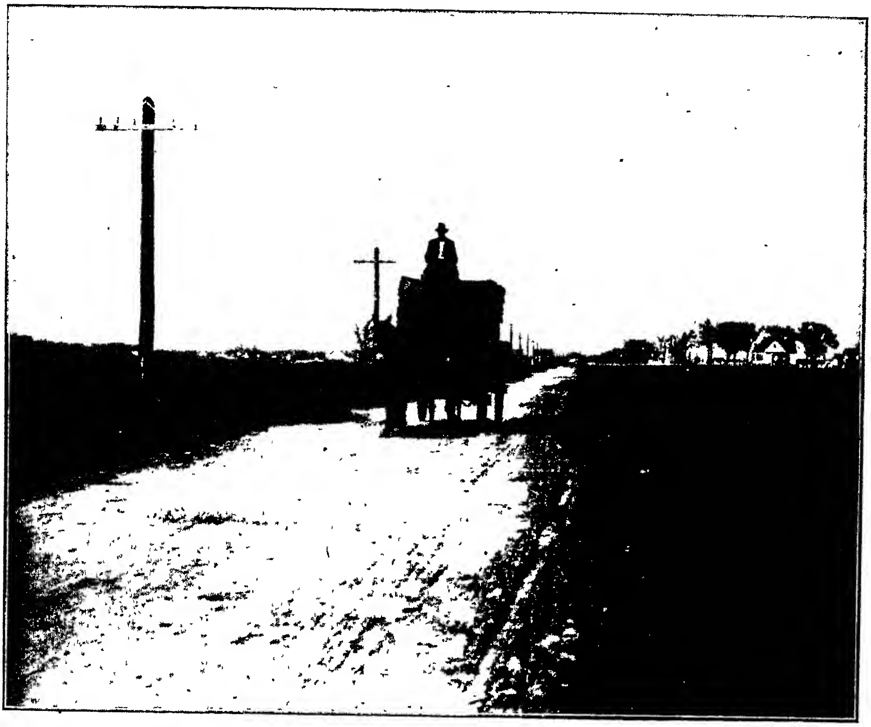

FIG. 1.—GRAVEL ROAD NEAR AUGUSTA, RICHMOND COUNTY, GA.

[Wagon loaded with 72 bales of hay.]

FIG. 2.—GRAVEL ROAD, SHELBY COUNTY, TENN., ABOUT 12 MILES NORTHEAST OF MEMPHIS.

[A thin deposit of gravel, such as is used in road building, is exposed in the ditch on the left side of the road.]

FIG. 1.—HAULING AND PULLING DOWN CLAY ON SAND-HILL ROAD.

FIG. 2.—A SAND-CLAY ROAD BUILT BY CONVICT LABOR IN RICHLAND COUNTY, S. C.

for spreading over the clay road is not found near by, pockets are made in the ditches for catching sand, which is later taken out and spread over the surface.

This work has been in progress during the past four years. Everything, even to the construction of the culverts and smaller bridges, except the guarding and supervision, has been done by convict labor. The size of the force has varied from forty to seventy prisoners, whose terms of sentence ranged from a few days to five years. During the year 1901 there have been on an average sixty prisoners, divided into two camps. The cost of their maintenance, including the guarding, feeding, clothing, and medical attendance during the year, has averaged 20 cents per convict per day, as compared with a cost of 30 cents per day per prisoner for feeding and guarding while confined in the county jail prior to sentence and assignment to the road force.

As a result of this work during the past four years this county now has (out of a total of about 650 miles of public roads) about 125 miles of improved sand-clay roads, 25 to 30 feet wide, which cost for grading and surfacing about $300 per mile, and 75 miles of similar roads, which, built under more favorable conditions, cost about $200 per mile (Pl. XXXI, fig. 2). In a few places, where the materials were close at hand and little grading was necessary, it is said that this work has been done at a cost not exceeding $150 per mile. The oldest portions of these roads have borne the traffic of three winters and three summers in a highly satisfactory manner, and the annual cost of repairs has not exceeded $10 per mile.

It would be a manifest error to suppose that similarly cheap and satisfactory sand-clay roads can be built in all other portions of the coastal plain region of the South Atlantic and Gulf States, for it must be borne in mind that the character and distribution of the sand and clay deposits of Richland County makes the road-building conditions there exceptionally favorable, and the management of the work has been very efficient. But the success in this county and the measure of success which has followed experiments on a smaller scale in other less-favored localities, certainly suggests a line of policy and experiment which promises cheap and fairly satisfactory results at small cost over much of the area of the South Atlantic and Gulf States.

THE GRAVEL ROADS IN SHELBY COUNTY, TENNESSEE.

Modern road building in Shelby County, Tenn., began about fifteen years ago with the construction of the gravel turnpikes which now radiate from Memphis, the county seat, toward the north, east, and south. Since that time the county has built some 350 miles of these excellent turnpikes, and is said to have expended in their construction and maintenance approximately $800,000. The grading for these roads

has been done largely by the county convict force (Pl. XXVIII, fig. 1); but the larger part of the quarrying, hauling, and spreading of the gravel has been done by hired labor under the contract system, only a limited portion of this work having been done by the convicts.

The management of these roads is vested in a turnpike commission consisting of three members, with the chairman of the county court as its head. The management of the convict force is vested in a workhouse commission or board, both commissions being appointed by and being responsible to the county court, which decides as to the tax to be levied for the support of the convicts and the general road-improvement policy to be followed. The turnpikes as constructed have a right of way of 50 feet. On this roadway gravel has been spread over its central portion to a width of 14 feet near the city and 12 feet farther out in the country (Pl. XXX, fig. 2).

The gravel used in the construction of these turnpikes is found in deposits varying from 5 to more than 20 feet in thickness in many portions of the county. It consists mainly of small, well-rounded pebbles of quartz, chert, and flint, cemented together with oxide of iron and a limited amount of clay. When these beds are broken down by blasting, and this gravel is spread on the road with care, so as not to separate from the pebbles the cemented material, it re-forms a hard, firm surface, which makes an excellent roadway. Where the distance does not exceed 2 or 3 miles, it is hauled by wagons from the pits to the road, but for longer distances it is hauled by rail to the nearest station, whence it is carried by wagons to the roads on which it is to be spread. Large quantities of the gravel used have been hauled by rail for a distance of more than 100 miles.

These gravel deposits are usually owned by private individuals, and the road authorities pay for it at the pit from $2 to $3 per car of 14 cubic yards. When spread over the roads for a thickness of from 6 to 8 inches, it has usually cost from $1,000 to $2,000 per mile.

The convict force during the year 1901 has included from 120 to 140 men, of which from 80 to 100 have been employed on public roads during the months of May to November. During this work season the prisoners have occupied temporary quarters in the country, traveling each day a distance of from 1 to 5 miles to and from their work. During the winter season, from November to April, the entire force of convicts is kept in their permanent quarters on the workhouse farm near the city, being used partly for farm work and partly for road and street improvements near by. The cost of employing these convicts on the public road is said to average about 40 cents per day per prisoner. The force has already rendered a most important service to the county by helping in the construction of its present turnpikes; but there will doubtless be a decided improvement, both in the efficiency and economy of operating this convict force for road-building purposes,

when the management is the same as that for the turnpikes, and when a better system of movable stockades or quarters is adopted, so that the prisoners may camp at night near to their place of work, and continue their road-building operations throughout the entire year.

MACADAM ROADS IN MECKLENBURG COUNTY, NORTH CAROLINA.

Modern road building in Mecklenburg County, N. C., and indeed modern road building in the State of North Carolina, may be said to have begun with the adoption of road laws nearly twenty-five years ago, which authorized each township in the county to levy a special tax for the maintenance and repair of its public roads, and permitted the commissioners to levy a special tax for the support of its convict labor in the permanent improvement of the county highways. This work has now been in progress for two decades on an increasingly large scale and with growing efficiency. At the present time this county maintains in connection with its public-road work two convict camps of from fifty to sixty prisoners each (Pl. XXVII, fig. 2).

The road-building equipment at each of these camps includes a quarrying outfit, a steam road roller, a stone crusher and engine, a road machine, scrapers, carts, wagons, mules, shovels, picks, etc. In the management of these convicts there is a guard for each ten or fifteen prisoners, and a local superintendent who has charge of the camp and the road work done by it. The entire road work of the county, including the management of both these convict camps, is under the control of the county superintendent of roads, who is also an engineer, and who reports monthly, and oftener if need be, to the board of county commissioners, which board decides upon the amount of road tax to be levied each year and exercises a general control over the work.

The county being situated in the hill country, the old roads with their steep grades have had to be relocated at certain points, and they have been graded by cutting through hills and building up intervening depressions until this grade work as seen to-day resembles that along a railway line (Pl. XXIX). These roads radiate out from Charlotte, the county seat. They have a width in the central township of 40 feet, of which 12 feet in the center has been macadamized, and a dirt road has been arranged on each side of this. In the rural portions of the county the width of the road has been contracted to 30 or 35 feet; the macadam track has in many cases been reduced to a width of 10 feet, and has been placed on one side of the road. This gives a double track—one, the macadam, to be used almost exclusively during the rainy season, and the other, the earth road, to be used generally during dry weather. This double-track system, which is much preferred by the farmers, prolongs the life of the macadam road by relieving it from traffic during dry weather (Pl. XXIX).

All of this work is being done by convict labor, and the long period

(five to ten years) for which many of the prisoners have been sentenced permits their being trained for expert work in the way of handling machinery and grading and macadamizing the roads. In connection with the cost of this work, it may be added that the maintenance of the convict force (including salaries of the guards and camp superintendent, and the clothing, board, tobacco, and medical attendance for the convicts) averages for the entire force for the year from 28 to 30 cents per convict per day. These convicts are housed throughout the year in comfortable portable structures, made of wood and corrugated iron, framed in sections, so that they are easily taken down and moved by a small portion of the squad from one point to another along the road (Pl. XXVII, fig. 2).

During the past twenty years, and largely during the past decade, 104 miles of such macadam roads have been constructed in Mecklenburg County by convict labor. At first, as might be expected, the progress made was slow and the work not always well directed, but year by year the county authorities have profited by their own experience and that of others, and during the past few years there has been a decided improvement both in the rate of progress and efficiency of management. During the year 1901, 12 miles of road have been graded and macadamized, at a cost ranging from $2,000 to $3,500 per mile, including the grading and macadamizing, the construction of culverts and abutments, and the materials for new bridges. The county is now expending annually something more than $40,000 on the improvement of its highways; and the proposition that this expenditure is the best-paying investment the county could possibly make is accepted by every class of citizens, and even by the convicts themselves, who seem to feel a genuine pride in the excellent highways they are building.

GRAZING IN THE FOREST RESERVES.

By Filibert Roth,
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INTRODUCTION.

In a consideration of the grazing problem in the forest reserves of the United States, it is necessary at every step to keep in mind the objects for which the reserves were set aside and the character, as well as the behavior, of the woods which exist on these several reserves. Since there appears to be still a great deal of confusion concerning the motives and objects which led to the formation of reserves, and also as to the character and behavior of forests in general, and the woods of the several reserves in particular, it may be helpful to review some of these points more in detail.

GENERAL DISCUSSION OF THE FUNCTIONS OF FORESTS.

When a farmer in Ohio or Indiana has a piece of woods on fairly level ground he has no good reason for keeping it as woods unless he considers the wood growing on the land to be as valuable as any other crop he might raise—a matter often difficult to decide. A farmer in Mississippi, on the other hand, may be induced to leave a patch of forest on a hillside, not because he cares much for the wood, but because, if the forest is cut away, the land will wash into a labyrinth of deep gullies and soon become utterly worthless for any purpose. In the former case the forest is merely for the crop it yields; in the latter it is for both crop and protection, and this case is far more common than is usually supposed. But while the farmer in Mississippi may use the forest to keep a piece of land from gullying, and thus use it as a protection against erosion, he cares little as to how this forest affects the flow of water or the climate, for he has ample rain and does not utilize the creek or stream. With the farmer in Gallatin Valley, Montana, this is quite different. He takes what seems to be a desert gravel bar and by the use of 1 inch of water per acre[1] he converts this arid ground into a farm and raises as high as 90 bushels of a superior quality of oats per acre. To him the little mountain stream is everything. Here the forest takes on another function; it holds the soil of the neighboring mountains and keeps it more pervious, and thus it regulates the flow in these important streams. The manner in which it does this will be clearer from the following: Suppose we take a table

[1] The inch of water here referred to is a miners' inch. Fifty miners' inches require a stream furnishing 1 cubic foot per second.

and tilt it several inches, so that its top represents a slanting surface. If we sprinkle water on this surface, it is clear that the water runs off about as fast as it strikes the table. If the table is now covered with a layer of soil about 3 inches thick, and the sprinkling is renewed, some of the water runs off from the surface and some soaks into the layer of soil, so that if, after a time, we quit sprinkling there will still be water running off from the table for hours. We have here then a "surface run-off" and an "underground run-off," and it is clear that the thicker the layer of earth, and the more pervious, the more water it would take up and the longer and steadier it would be giving off this underground water.

The above statement shows exactly what happens all over the land, and is especially noticeable in the mountains. On the soilless, rocky slopes the water runs off as fast as it falls or the snow melts, but on slopes with deep, pervious soils part of the water is stored and continues to flow for months after the rain or the melting of snow has ceased.

Returning to the experiment with the layer of earth on the table, we notice that if we sprinkle more briskly, part of the earth is carried away, the layer is eroded, and the storage ground is diminished. If covered by a layer of cotton batting this erosion stops, and in addition we gain another very important point—the soil is kept softer, and allows water to soak in more easily than when the cotton is wanting, for then the water "pats" down; it hardens the surface where it does not wash it away. Much the same result might be obtained by sowing grass on the layer of earth, for then the tops of the grass would keep the drops from pounding the earth, form a mechanical obstacle to the surface run-off, and the roots would be an additional help in holding the earth and keeping it from washing away. But the grass is small, its tops are short, open, and close to the ground; its roots are short; it rarely forms a dense sod, and, especially in dry countries, it leaves a large part of the ground without protection. Here, then, the larger, long-lived, deep-rooted trees, with dense, shading crowns high above the ground, give far better and more constant protection against erosion, and are far better able to keep the ground in a pervious condition, since they strew it annually with large quantities of leaves and twigs and provide a network of slowly decaying roots which keep the forest soil mellowed for a foot and more in depth. An upturned hemlock, spruce, etc., will readily illustrate how much of the ground is occupied by the roots of these forest trees.

The trees, then, are in nature what the cotton is in the experiment; they help to keep the soil from being carried away, they keep it soft, and they break the force of the downpouring rain.

How much additional service trees perform by keeping sun and wind from the ground is well illustrated by the forests of the Lake States and Canada, where thousands of swamps have dried up and hundreds

of miles of corduroy road have become useless, not by ditching and draining, but by removing the woods and giving sun and wind access to the soil.

In this connection, it may be well to mention a theory, sometimes advocated, which teaches that it would be better for water-storage purposes to have the forests removed in order that the snow may gather in large drifts, since, as it is claimed, it is these snowdrifts which supply the water of the streams throughout the dry summer season. This is not borne out by facts, for a study of the Big Horn Mountains and the Rockies of Wyoming, Montana, or Idaho will convince anyone that the few lingering snowdrifts of August have very little to do with the streams, and that it is the wooded and not the bald districts of each basin which serve as feeders and maintain the steady flow of water. The allied claim that snow melts more quickly in the forest than in the open is so palpably inconsistent with actual experience and simple physics that one might as well claim that the construction of an ice house to cover the season's supply was unnecessary, since ice would last longer in the sun than under cover.

Though there exist numerous forests in this country where the protective function of the woods is not apparent, in the majority of cases, and in all mountain districts without exception, the forest serves both to supply useful material and to protect and improve the ground, and thereby regulate the surface and underground drainage.

THE OBJECT OF THE RESERVES AND THE CHARACTER OF THEIR FORESTS.

For the forests of the present reserves it may be said that the protective function has been regarded as the more important. It is evident, therefore, that efforts will be made to maintain and improve these woods in order to continue to increase their usefulness in furnishing material, and still more in performing their protective function. This is the object of the forest reserves. The main purpose of the reserves is not exclusion, as is still so often claimed. They merely provide the means and men to give the much-needed care and protection which private enterprise at present could not afford and probably would be unwilling to furnish for a long time to come.

Scattered over a wide range of country, from the British line to Mexico, with climates varying from cold to hot, from excessively wet to arid, in altitudes of from 1,500 to 11,000 feet, the forests of the several reserves differ widely. In the Black Hills a fine forest of Yellow Pine covers a broad expanse of high, rolling ground and hills, and serves chiefly as a valuable source of timber. In the Western Rainier a dense forest of fine conifers on steep alpine ridges keeps the waters from carving the mountains into a waste. In the Big Horn a growth of pole-size Lodgepole Pine occupies a rough plateau, ranging

from 8,000 to 9,000 feet in altitude, and helps to keep the useful streams from going dry.

Similarly, these woods differ in their present condition. The valley of the Skagit in the Washington Reserve is almost an unbroken burn, and large burned-over areas, known as "burns," are scattered over the majority of the ridges of the east side of this same reserve. Similar conditions are met in the Mount Rainier, the Big Horn, the Priest River, and other reserves. In some cases these old burns have become reclothed with young forest trees, in others they are thickets of brush (species not trees), and in others they have changed to grassy pastures, often with little prospect of restocking under the conditions now prevailing. In some cases, as in the Big Horn Reserve, part of the extensive old burns are now so unmistakably prairie that it is difficult to prove that they were ever woods. Generally, however, a search reveals some fragments of stumps, bits of charcoal, etc., which show that at some time, at least, these places were not altogether prairie, and that a return to a wooded condition may be looked for. Besides these parks or grassy openings and small prairies (probably all due to fire), which in the aggregate cover many thousands of acres, there are large tracts of forest, such as the Yellow Pine woods of the Black Hills, where the mature timber, in keeping with the habits of this kind of pine, no longer forms dense stands. Here the ground is but little shaded, and a vigorous growth of grass and weeds eagerly seizes upon every yard of available soil, and thereby often prevents the starting of tree growth. (Pl. XXXII.)

In other districts, where high altitudes tend to give an alpine character to the land, tree growth naturally becomes more scrubby and broken, and, in regions like the Cascades, at the tops of the high ridges are grassy parks, covering many thousands of acres more or less interrupted by patches of scrub woods. Whether these grassy areas were ever entirely clothed with woods, and whether, with any reasonable amount of care or protection, they can be made to reclothe themselves, is still in some cases uncertain.

In general, then, the forests of the reserves are primarily protective forests, they differ from reserve to reserve, they are all more or less damaged by fires, and in all dry localities and at high altitudes they are interrupted by grassy areas, the majority of which have long been in their present condition, and will probably require a long period of time before they are restocked with woods. (Pls. XXXIII and XXXIV.)

REGULATIONS FOR GRAZING IN THE RESERVES.

When the several reserves now in existence were created, the majority of them included districts which had been used for some time for grazing purposes, and the attempt to stop further grazing affected interests of considerable magnitude.

FIG. 1.—AN OLD BURN AS SHEEP RANGE. MOUNT RAINIER RESERVE.

FIG. 2.—SHEEP IN OPEN-PARK WOODS OF YELLOW PINE. BLACK MESA RESERVE.

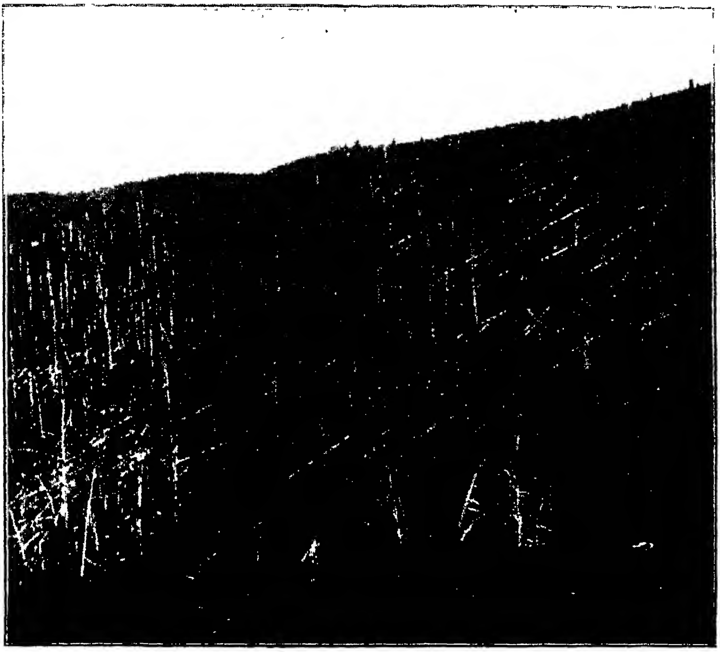

FIG. 1.—OLD BURN WITH DENSE GROWTH OF YOUNG PINE ("TOO MUCH BRUSH"), NOT USED AS RANGE. WASHINGTON RESERVE.

FIG. 2.—OLD BURN IN THE ALPINE REGION OF THE CASCADES (LITTLE REPRODUCTION AND POOR FEED). WASHINGTON RESERVE.

PRESENT RULES FOR GRAZING IN THE RESERVES.

At present, the following ruling of the General Land Office, based on the law approved June 4, 1897, and published in a circular, "Rules and regulations governing forest reserves," November 6, 1900, govern in all affairs of grazing within the reserves:

Pasturing of live stock.—The pasturing of sheep and goats on the public lands in the forest reservations is prohibited: *Provided,* That in the States of Oregon and Washington, where the continuous moisture and abundant rainfall of the Cascade and Pacific Coast ranges make rapid renewal of herbage and undergrowth possible, the Commissioner of the General Land Office may, with the approval of the Secretary of the Interior, allow the limited grazing of sheep within the reserves, or parts of reserves, within said States. *And also provided,* That when it shall appear that the limited pasturage of sheep and goats in a reserve, or part of a reserve, in any State or Territory will not work an injury to the reserve, that the protection and improvement of the forests for the purpose of insuring a permanent supply of timber and the conditions favorable to a continuous waterflow, and the water supply of the people will not be adversely affected by the presence of sheep and goats within the reserve, the Commissioner of the General Land Office may, with the approval of the Secretary of the Interior, also allow the limited grazing of sheep and goats within such reserve. Permission to graze sheep and goats within the reserves will be refused in all cases where such grazing is detrimental to the reserves or to the interests dependent thereon, and upon the Bull Run Forest Reserve in Oregon, and upon and in the vicinity of Crater Lake and Mount Hood, or other well-known places of public resort or reservoir supply. The pasturing of live stock, other than sheep and goats, will not be prohibited in the forest reserves so long as it appears that injury is not being done the forest growth and water supply, and the rights of others are not thereby jeopardized. Owners of all live stock will be required to make application to the Commissioner of the General Land Office for permits to graze their animals within the reserves. Permits will only be granted on the express condition and agreement on the part of the applicants that they will agree to fully comply with all and singular the requirements of any law of Congress now or hereafter enacted relating to the grazing of live stock in forest reserves, and with all and singular the requirements of any rules and regulations now or hereafter adopted in pursuance of any such law of Congress; and upon failure to comply therewith, the permits granted them will be revoked and the animals removed from the reserves. Permits will also be revoked for a violation of any of the terms thereof, or of the terms of the applications on which based.

PRINCIPLES FOR FUTURE REGULATIONS FOR GRAZING IN THE RESERVES.

In the future, the following principles, lately announced by the Secretary of the Interior, will be the basis of all grazing regulations in the reserves. The central idea is cooperation between the Government and the grazing interests in securing the best management and bringing about the best condition of the range.

(1) The Government, through its forest officers, after consultation with the representatives of the various interests involved, should decide on the number of head to be grazed in each forest reserve, or each subdivison of a reserve, and should establish the boundaries between cattle range and sheep range.

(2) The local association should assign ranges to owners within the limits thus laid down, subject to official approval.

(3) Both owners and local associations should be held responsible for the observance of the terms of permits and the prevention of fire and overgrazing.

(4) Each sheep owner should have the exclusive right to his range, and the same should apply within reasonable limits to groups of cattle owners.

(5) Permits should run for five years.

(6) Residents should have precedence in all cases over tramp owners and owners from other States.

(7) Local questions should be decided on local grounds and on their own merits in each separate case.

(8) Since the forest reserves are usually summer ranges, provision should be made for necessary routes of transit.

(9) The policy of the Government should be based on regulation rather than prohibition, except in special cases, it being understood that the avoidance of overgrazing is equally in the interests of all parties.

Grazing of sheep is permitted in parts of eight of the reserves. Cattle are allowed in all. Anyone wishing to use the reserve pastures must obtain a permit. These permits are granted free of charge; the number of animals is limited, and the time of entrance into and exit from the reserve, as well as the district where they are to graze, is decided by the Department of the Interior.

In carrying out these principles the rules now adopted are: Wherever an association of sheep men exists, which represents the majority of those who have for at least two years used the reserve pastures, such an association is recognized. Blank applications are sent to the secretary of the association, and he distributes them and gets them filled and signed. He then transmits them to the supervisor, and the latter to the Department, when permit is issued. To set forth more definitely the requirements of the Department and the conditions of such a permit, the following appears printed on every application and permit:

This application is also made with the understanding, and full agreement thereto, that penalties will be imposed for a violation of rules as follows:

PERMITS CANCELED AND REFUSED.

1. For obtaining or attempting to obtain a permit on false representations.
2. For willful trespass upon areas where not permitted, either on closed areas or the ranges of others.
3. For setting out fires to clear range.
4. For *willful* negligence in leaving camp or other fires.
5. For refusing to observe promptly any direct order from the Department requiring an observance of any rule.

OTHER PENALTIES.

The number of sheep covered by a permit to be materially reduced for the following stated causes, viz:

1. For crowding onto a neighbor's range without the consent of said neighbor.
2. For bedding sheep more than six nights in succession in any one place, except when bedding bands of ewes during lambing season.
3. For entering the reserve prior to the date authorized.
4. For remaining in the reserve after the permit has expired.
5. For corralling within five hundred yards of a running stream or living spring.

FIG. 1.—ALPINE PARK WOODS NEAR COWLITZ PASS, ON THE CREST OF THE CASCADES. MOUNT RAINIER RESERVE.

FIG. 2.—A SITUATION WHERE THE GROUND NEEDS ALL THE COVER IT HAS. BLACK MESA RESERVE.

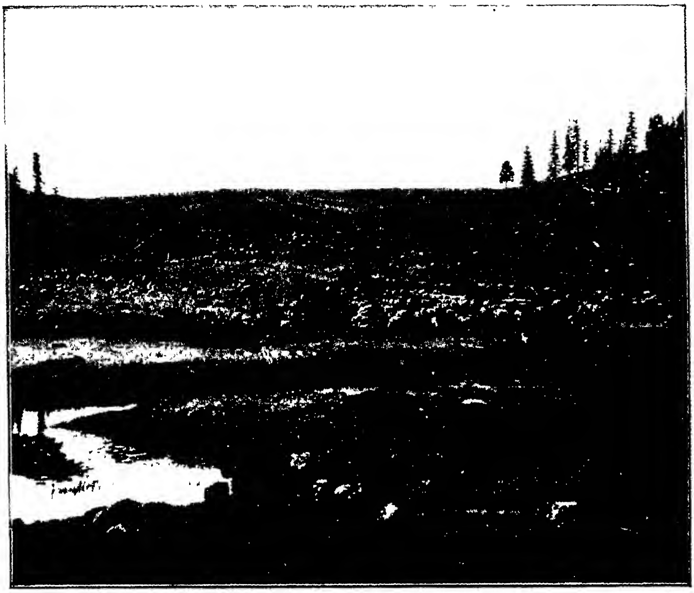

FIG. 1.—COMMON SHEEP RANGE. BLACK MESA RESERVE.

FIG. 2.—SHEEP RANGE ABOUT MOUNT ADAMS. MOUNT RAINIER RESERVE.

6. For gross carelessness in leaving camp fires.

7. For failure to aid in extinguishing a fire occurring within the range occupied when possible to do so.

8. And for such other minor violations of the rules as may occur.

9. For failure to remove sheep promptly upon order of forest officer when damage is being done to the range.

10. For failure of herder to corral for count, upon order of forest officer or ranger, when number of sheep appears to be greater than the number covered by permit.

I also agree to forfeit the permit for a violation of any of its terms or of the terms hereof or whenever an injury is being done the reserve by reason of the presence of the animals therein.

(Signed) ——— ———.

EXTENT OF GRAZING IN THE RESERVES.

The following tables show the extent of grazing in the reserves:

Sheep grazing in the reserves in 1901.

Reserve.	Area in reserve.	Number of sheep allowed in reserve.	Grazing season allowed for calendar year 1901.	Number of permits issued.	Number of sheep covered by permits issued.
	Acres.				
Black Mesa, Arizona	1,658,880	225,000	April 1 to December 1	57	176,485
San Francisco Mountains, Arizona.	975,360	125,000	.....do	[a]20	90,700
Gila River, New Mexico	2,327,040	225,000	January 1 to August 31	30	134,320
Uinta, Utah	875,520	200,000	July 1 to October 1	87	188,050
Cascade Range, Oregon	4,588,800	200,000	June 15 to October 15	44	166,050
Big Horn, Wyoming	1,147,840	150,000	June 1 to September 20	[b]54	150,000
Mount Rainier, Washington	2,027,520	250,000	July 1 to September 25	89	249,713
Washington, Washington	3,426,400	25,000	.....do	[c]6	25,000
Total		1,400,000		387	1,180,318

[a] Five additional applications covering the remainder of the sheep allowed are pending.
[b] Thirty-four additional applications covering 99,400 sheep were rejected.
[c] Sheep allowed only in Okanogan County.

Cattle and horse grazing in the reserves in 1901.

Reserve.	Area in reserve.	... the reserve.			Permits issued.	... issued.		
		Cattle.	Horses.	Cattle and horses combined.		Cattle.	Horses.	Cattle and horses combined.
	Acres.							
Black Mesa, Arizona	1,658,880	25,000	5,000	30,000	97	15,618	2,259	17,877
Prescott, Arizona	423,680	2,500	1,000	3,500	9	77	15	92
Grand Canyon	1,851,520	10,000	2,500	12,500	15	505	516	1,021
San Francisco Mountains, Arizona	975,360	20,000	5,000	25,000	110	11,311	3,364	14,675
Gila River, New Mexico	2,327,040	55,000	10,000	65,000	183	41,061	4,618	45,679
Pecos River, New Mexico	431,040	10,000	2,500	12,500	147	3,757	845	4,602
Lake Tahoe, California	136,335			[a]2,500	13	1,780	205	1,985
Stanislaus, California	691,200			[a]8,000	39	6,603	692	7,295
Sierra, California	4,096,000			[a]30,000	180	24,775	1,090	25,865

[a] Each horse to count as two head of cattle.

Cattle and horse grazing in the reserves in 1901—Continued.

Reserve.	Area in reserve.	Stock allowed to enter the reserve.			Permits issued.	Stock covered by permits issued.		
		Cattle.	Horses.	Cattle and horses combined.		Cattle.	Horses.	Cattle and horses combined.
	Acres.							
Pine Mountain and Zaka Lake, California	1,644,594	....	....	(a)	20	893	40	933
Santa Ynez, California	145,000	....	....	(a)	12	38	48	86
San Bernardino, California	737,280	....	....	(a)	18	3,005	40	3,045
San Gabriel, California	555,520	....	....	(a)	25	266	131	397
San Jacinto, California	737,280	....	....	(a)	16	1,080	....	1,080
Trabuco Canyon, California	109,920	....	....	(a)	4	210	....	210
Battlement Mesa, Colorado	858,240	....	....	47,000	149	43,065	3,931	46,996
Pikes Peak, Colorado	184,320	....	....	4,800	16	1,374	46	1,420
Plum Creek, Colorado	179,200	....	....	7,500	43	3,686	229	3,915
South Platte, Colorado	683,520	....	....	26,000	82	13,447	361	13,808
White River, Colorado	1,198,080	....	....	61,000	154	40,335	1,968	42,303
Fish Lake, Utah	67,840	....	....	2,100	5	370	4	374
Uinta, Utah	875,520	....	....	10,500	60	4,313	7	4,320
Bitter Root, Montana	691,200	4,000	2,000	6,000	1	400	0	400
Flathead, Montana	1,382,400	5,000	2,000	7,000	39	64	181	245
Gallatin, Montana	40,320	3,000	1,000	4,000	3	125	20	145
Lewis and Clark, Montana	2,926,080	20,000	7,000	27,000	52	5,968	775	6,743
Cascade Range, Oregon	4,588,800	3,800	550	4,350	12	1,535	10	1,545
Black Hills, South Dakota and Wyoming	1,211,680	....	....	7,000	166	5,720	1,276	6,996
Big Horn, Wyoming	1,147,840	....	....	15,000	123	13,805	1,179	14,984
Teton, Wyoming	829,440	....	....	2,000	32	1,742	212	1,954
Mount Rainier, Washington	2,027,520	....	....	6,000	94	5,689	240	5,929
Olympic, Washington	2,188,800	750	250	1,000	2	129	....	129
Washington, Washington	3,426,400	....	....	7,500	0	0	....	0
Total	....	....	....	434,750	1,921	252,746	24,302	277,048

[a] Only the stock of settlers living within and immediately adjacent to the reserves allowed therein.

METHODS OF "RUNNING" STOCK AND THE EFFECTS ON RANGE AND WOODS.

Being mostly high mountain country, the reserve pastures can not be used throughout the year, but serve as summer range. The animals are wintered outside of the mountains, on a regular "winter range," usually extensive, dry prairie country where the snowfall is not sufficient to prevent grazing. Some of these winter ranges are practically desert regions through the summer, lacking both feed and water. Others furnish enough of forage, but the feed is dry and there is no drinking water on large portions of the districts, so that grazing on such ranges is poor and is limited to the vicinity of water holes or streams. (See Pl. XXXV.)

Generally, these prairie ranges are less suited as summer pasture to sheep than to cattle, since the latter stand the dry feed and intense summer heat better than do the sheep.

In the spring of the year the live stock is driven to the mountains and held there until the fall or winter storms drive them back to the winter range. In this way the reserve and other mountain pastures serve a rather peculiar function, and the indirect value of these mountain pastures is often greater than the direct value. They not only furnish pasture for a certain number of head of stock for a certain period, but by serving as summer range they make it possible to use large, arid regions for winter range, and thus greatly extend the grazing industry. For instance, the mountains included in the Mount Rainier Reserve have for years furnished summer range for about 250,000 head of sheep and several thousand head of cattle. Since the summer range outside of the reserve is mostly occupied and since the winter range is too dry to be used during summer, it may be said that the reserve pastures are essential to the maintenance of the bands in this section of Washington. It follows that closing these pastures would lead either to a reduction of the bands by about the number enjoying summer range, or to a radical change in the way of running sheep, and since these sheep represent a gross income of about $2 to $2.50 per head. a year, such a reduction would materially affect the income of these communities until offset by the change just mentioned. With owners of cattle, usually farmers, near the boundaries of reserves the same conditions prevail. In the case of farmers and stockmen living within the reserves, the pastures of the reserves are, of course, their only available range, and, in many cases, are of more value to the farmers than the farms themselves.

Since the handling of sheep and cattle differs in many important points, the two cases are best considered separately, and since sheep grazing in the reserves is at present the more important of the two, it will be considered first.

SHEEP GRAZING.

Time of entering the range.—The sheep of the Western mountain regions (generally "grade" Merinos and coarse-wools mixed) are owned for the most part by residents of the counties in which the reserves lie. They are run in flocks or "bands" of 2,000 to 3,000 head, in charge of a herder who is assisted by a "camp tender," "packer," or "camp rustler," whose business it is to look up range, move camp, and "pack" in supplies, including salt for the sheep.

The time of entering the reserves naturally varies with the climate of the particular district. In the northern reserves the herds are lambed and sheared before they begin their journey to the mountains, but in the southern reserves, as, for instance, the Black Mesa of Arizona, the shearing commonly precedes the lambing, the latter taking place in the reserve, and in some cases the sheep are sheared and lambed in the reserve.

Accordingly, the sheep enter the Black Mesa as early as April, while those of Mount Rainier do not reach the reserve line before the

middle of June or the beginning of July. Similarly, the sheep of the Black Mesa remain in the reserve until November; those of the Rainier, Big Horn, etc., are driven out by the fall storms as early as from the middle to the end of September.

Of late years a definite time of entering and leaving the reserve has been prescribed for each reserve, according to location and other conditions, much to the improvement of the range and also to the general satisfaction of the better sheep men.

JOURNEY TO THE MOUNTAINS.—In their journey to the mountains the sheep are usually obliged to follow certain natural highways, and their progress and the work of handling them is largely governed by the surroundings. Wherever possible, the sheep are allowed to travel slowly and graze as they go. Where these bands are obliged to move right along, as, for instance, in rocky defiles, patches of timber, etc., where no feed exists, the band is held close, the sheep are obliged to crowd closely together, and in consequence the trail takes on somewhat the appearance of a wide, much-traveled road. The small vegetation is destroyed, the ground is worn into numerous rut-like trails, and the bushes and small trees along these trails are rubbed and nibbled, and in some cases more or less barked and killed. Since these trails are commonly 50 to 100 yards in width, they are very conspicuous, and since they usually serve for ordinary travel as well as for the sheep, they are seen by many, and often, no doubt, the condition of the range, on the whole, is judged by these unsightly trails.

Where many bands travel the same trail and occupy the same summer range there is considerable rivalry, and in crowded districts the journey into the mountains often becomes a regular race for the better camps, much to the detriment of the sheep and range. Before the time of entrance was definitely regulated, men would start early and follow closely upon the receding snow. The freshly shorn sheep were exposed to the severities of storms, and were exhausted by rapid traveling. The range suffered even more—the ground was still wet, the feet of the animals sank deeply, and the sod was cut and damaged. In addition, the grass had just started; it was still too short to make good grazing, and thus the sheep were induced to run, and required extra moving. In this way considerable areas in nearly all reserves were completely ruined. The result is that the mat of vegetation has disappeared and the ground is bare.

A proper reduction of the number, the regulation of the time of entrance, and the division of the range have done much to prevent these injuries, and in some places a reclothing of such areas has been observed.

OCCUPATION OF THE RANGE.—The manner of occupation of the summer range differs in different reserves. Thus, in the Big Horn the several bands go wherever there is room and feed, the same band

FIG. 1.—PINE NIBBLED BY SHEEP. BIG HORN RESERVE.

FIG. 2.—PINE NIBBLED BY SHEEP. BLACK MESA RESERVE.

FIG. 1.—SHEEP IN THE OPEN-PARK WOODS OF YELLOW PINE (PINE SEEDLINGS SURE TO SUFFER). BLACK MESA RESERVE.

FIG. 2.—CONDITIONS UNDER WHICH THE SEEDLINGS SUFFER. BLACK MESA RESERVE.

occupying any part in the opened portion of the reserve. In the Rainier the range is divided into sheep and cattle ranges, the sheep range being divided into five well-defined districts, and each band of sheep receives a permit for only one of these districts. This measure has proven of great value by reducing the needless roaming of the numerous bands. In a few localities this division is carried a step further, and each man claims a certain territory or range by right of priority, in some cases reinforced by the fact that the stockman owns some lands within the range, including usually the best watering places, with some buildings and other improvements.

Generally, the law of priority prevents one herder from crowding in on the range of another, but when the entire range is crowded and feed is short, as in dry seasons, necessity sets aside all established rules.

THE MANNER OF GRAZING.—The grazing itself is quite similar everywhere. In the morning the band leaves camp, spreads out when it reaches good feed, grazes for some hours, rests during the warmer part of the day, resumes grazing, and toward evening returns to camp, where it is "bedded" on a piece of well-drained ground, preferably an open hillside.

Where a camp is used for a considerable time, especially in the case of large bands, this daily return to the same bedding ground is one of the most objectionable features of sheep grazing in the mountains. On the bedding ground itself everything is destroyed, and the ground is covered with a deep layer of manure which, if the sheep are bedded near a stream, washes down into the stream during heavy rains, and thereby pollutes the water.

In a fresh camp the sheep spread out at once in the morning and feed away from camp. But after some nights of bedding in the same spot, the ground about the camp ceases to have palatable feed, and the sheep merely travel over it, usually in a dense body, with from 10 to 50, traveling in the characteristic single file. This soon cuts the ground and grass along definite lines, and in a couple of weeks there are dozens of rut-like trails leading in all directions from the camp. This naturally grows worse, and each day sees more of this cutting of trail than the preceding, since the distance becomes greater and greater. That this evil is worse with larger bands than with smaller ones, and that it is worse on the poorer and closer-cropped ranges and during unfavorable seasons, is self-evident.

If the camp is located near or in timber, this frequent, forced return to the same bedding ground leads the sheep to mutilate young trees by nibbling and rubbing, even though they do not care for any part of the trees as forage. But what is even worse, the frequent march over the same ground by densely massed bodies of sheep necessarily destroys much young growth, particularly in the seedling stage. (Pls. XXXVI and XXXVII.)

In addition to the injury to range and woods, this persistent trailing back and forth to camps naturally affects, or rather disturbs, the surface conditions of the ground. Keeping in mind our illustration of the layer of earth on the table, it is clear that the cutting short of the grass cover, or the forest floor, has some influence on the run-off of water, and that this influence invariably is to increase the rate of run-off, and thereby the power of the water to carry away the soil. That the many thousands of little trails, cut as they are in parallel lines along the hillsides of every valley, naturally act as so many ditches, facilitate greatly the run-off, and establish definite lines of erosion, is equally clear.

HERDING.—In herding through the day, the sheep rarely go much more than one mile from camp, generally less. The herding itself depends mostly on the herder, but also on the character of sheep and range. Some men keep the sheep close together, and move them along while feeding; others allow them to spread as they please, and merely watch them to avoid loss from straying off and from wolves, etc. Where the sheep are held close, the strongest ones usually form the front and sides of the band, and get the pick of the feed, while the poorer ones in the center and rear must content themselves with the leavings. This naturally leads to restlessness, and involves much useless travel, which is still increased by the frequent use of the dog. At every turn the dog is sent to drive back, and every time he does so the feeding of part of the band is interrupted, and there is more or less crowding and running, which in every case means trampling and destroying of feed instead of using it. It should not be inferred that this close herding is always a mere matter of disposition or due to lack of experience, for such is not the case. During and just after lambing, in territory with many wolves, on old burns with much down timber, on very rough and rocky ground, in "brushy" country, in some cases during storms, and in fact wherever it is impossible to see the sheep a long distance, and where there is danger of straying off, close herding is necessary, and a certain amount of this must, therefore, always be expected.

FOOD PREFERRED.—The feed in these mountains is usually divided into three classes—grass, "weeds" (herbaceous vegetation other than grass), and "browse" (leaves and twigs of shrubs and trees). Most camps or ranges contain all three. Regular browse camps are the exception, and an all-grass range is rarely satisfactory sheep ground. In feeding, the sheep loves variety, prefers the short green feed, takes nearly everything, and thus cuts clean and close. On nearly all ranges this close cropping, together with the trampling, kills out some of the less resistant grasses and other plants and leaves the ground to the more resistant. A common and well-known example of this is seen where the mountain bunch-grass is killed out, frequently leaving the ground more or less bare for some time, when the more resistant grasses restore the cover.

Generally, the sheep do not eat any of the conifers or real forest trees of these mountains. They nibble them and injure them by crowding and nibbling about bedding grounds and along trails, and they feed on young trees and boughs of conifers in cases of dire necessity, but by far the greatest injury to tree growth undoubtedly consists in the trampling of seedling trees.

SOME RESULTS OF GRAZING ON THE RANGES.—In all cases of grazing the range is cut close, and this close shaving of the vegetable cover, together with the loosening of the soil, especially on all hillsides, naturally results in an appreciable change of the surface conditions and consequent surface run-off.

That lazy herding, where a camp is fairly "worn" out, and that all overstocking, and consequent overgrazing, increase the several kinds of injury here pointed out, goes without saying.

But while it is thus quite evident, therefore, that sheep grazing can never be conducted without more or less injuries, it is unfair to suppose, as has been too often the case, that grazing always results in serious mischief, and should, therefore, be forbidden.

To be sure, the bedding ground and trail are unsightly wastes, but they form a very small percentage of the entire area and in many cases occupy rough, rocky waste ground, of little importance for any purpose. In addition, it must be stated that the best sheep men have given up the old method of bedding for long periods in the same place and are adopting the proper way, bedding only one or at least only a few nights in a place; also, that most of the ordinary bedding grounds rapidly recover and, when once reclothed with grass, far excel the surrounding ground, so that many of these old bedding grounds are conspicuous by the luxuriance of their vegetation.

Similarly, the damage to the forest growth, even along the trails and about bedding grounds, has so far proven a serious permanent mischief only in a few special localities, such as parts of California and Arizona, where unfavorable peculiarities of climate and soil combine to resist the reproduction of the forest, and therefore need but little assistance, supplied by the sharp foot of the grazing animal, to prevent young growth altogether. In other localities, such as the Big Horn, the Rockies of Montana, and the Cascades of Washington, one meets some of the finest cases of natural reproduction of pine in the immediate vicinity of trails and bedding grounds. Such cases demand consideration, and seem to throw much doubt on the sweeping statements commonly made.

In the same way the matter of aggravated erosion due to grazing seems often overdrawn. As above indicated, there is no grazing without disturbance of the surface conditions, and there are numerous instances on record where overgrazed areas (overgrazed by cattle as well as by sheep) have begun to "gully," and otherwise show serious signs of mischief from erosion. Even in the many districts where

more resistant soil has so far held firm, and the general appearance is such as to mislead most men into the belief that no disturbance exists, a closer scrutiny usually proves that all badly treated, overgrazed areas have suffered injury, and that a more general injury may be looked for in time. Nevertheless, it must be conceded that in several of the reserves the disturbance due to this cause is thus far insignificant, and that it is reasonable, therefore, to suppose that with proper limitations grazing may be carried on without great damage.

In judging the mischief done by sheep to the range itself, it is a common error to mistake a short-cropped range for a poor or injured range. Some of the older ranges, like the Red Desert of Wyoming, were on this account supposed to be "all killed out" more than fifteen years ago, and yet these very same ranges support as many sheep as ever, and support them fully as well. Similarly, parts of the Cascades have been used, and used hard, for many years, but in spite of being closely cut, and in spite of the fact that the tall bunch grass has long disappeared, the bands do as well as ever. This fact is so well known that it has misled many of the stockmen into the belief that since it is true with them it must be true everywhere. Such, however, is not the case. In some of the California and Arizona districts the mountain range, like that of parts of the lowland prairies, has been destroyed by overstocking, and there is good reason to believe that unlimited grazing, like unlimited lumbering, will result everywhere in general destruction of range as of forest. (Pl. XXXVIII.)

Firing the woods of the range.—A mischief far more serious than any above mentioned, namely, that of setting fire to the woods, is often charged to the sheep industry, as though it were one of the natural consequences of this business. How far these charges are based upon prejudice against the sheep industry is difficult to say. To charge the sheep men with the many burns seems hardly fair, since the ungrazed portions of the same reserve often present as many and as extensive burns as do the regular ranges. Similarly, it seems to be now quite generally conceded that little, if any, benefit is derived from setting fire to the range, a practice quite common in the pineries of the South and elsewhere. Frequently it was argued that because many of the reserve pastures are located in burns it was fair to assume that these reserve pastures might be, and probably were, improved and extended by fires.

As matters stand, it would appear from observation and evidence that none of the reserve ranges are materially benefited by firing. Being mountain pastures, the feed is green; and being closely cropped, there is no need of removing tall dead grass, as is the case where firing is practiced. In dense, standing timber and windfalls fires usually produce sufficient heat to destroy all vegetation, and in addition leave the ground in such a condition that there is little or no feed for years. To set fire in such a place the herder endangers his camp outfit and

IN THE GILA RESERVE, WHERE GRAZING NEEDS REGULATION.

FIG. 1 -TALL GRASS, WHERE FIRE IS APT TO SPREAD. BLACK MESA RESERVE.

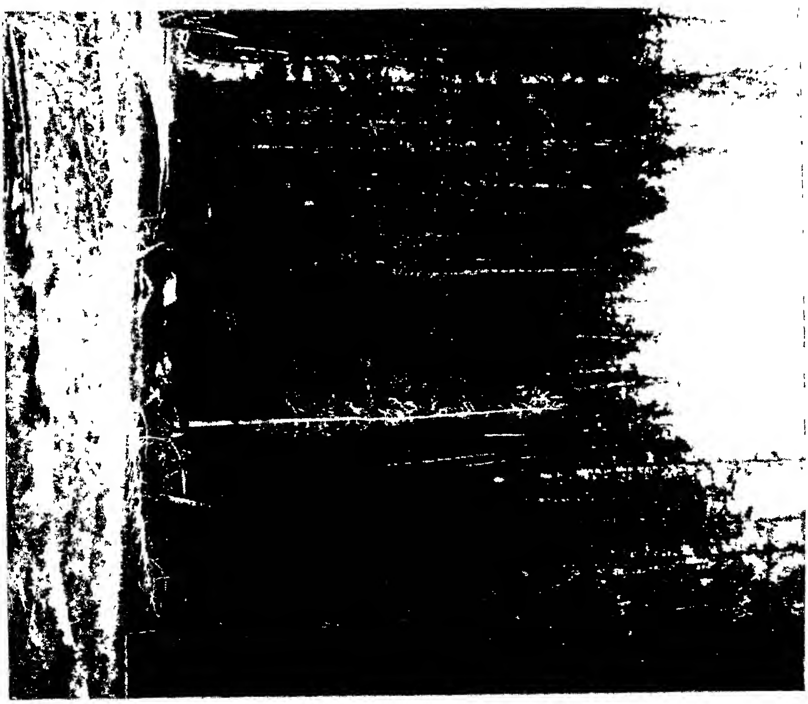

FIG. 2.—SHEEP RANGE IN TALL WOODS.

sheep, loses a large amount of valuable feed, and can not hope to gain any material benefit for a number of years, by which time he will in all likelihood have abandoned the particular range.

While carelessness in the management of camp fires, etc., is possible with sheep herders, as with other persons, it must be granted that their experience, together with their material interests, would naturally check and correct such deficiencies. In addition, it seems proper to state that the experience with fires in the Big Horn Reserve during the summer of 1900 clearly proves that with a cordial cooperation of sheep men and rangers, the former furnish a very desirable body to draw from in case of emergencies. Where it requires from two to four days to fetch men from beyond the limits of the reserve, such assistance from the sheep men may be of the greatest importance.

In denying the charges of firing the woods, the sheep men correctly point out that the closely fed park lands are less liable to be fired, and that in many cases fires have actually come to an end when reaching closely cropped sheep ranges. (Pl. XXXIX.)

CATTLE GRAZING.

As stated above, the grazing of cattle is not forbidden. The cattle are owned mainly by farmers and small stockmen living near or in the reserve. Generally, and very properly so, a definite range is set aside for cattle, from which sheep are entirely excluded. Usually a number of cattle owners join in bringing their cattle into and out of the mountains.

Like sheep men, the owners of cattle make application to the supervisor for the privilege of grazing their stock in the reserve. To residents within the reserve whose herds do not exceed 100 head the supervisor may grant the grazing privilege himself; all other applications he merely transmits to the Department of the Interior with his recommendations, and the permit is issued by the Secretary. As in the case of sheep men, preference is given to the different cattlemen in the following order: (*a*) Residents within the reserve; (*b*) persons owning farms or lands within the reserve; (*c*) persons living near the reserve; (*d*) persons living distant from the reserve.

Persons not residing in the State where the reserve is located and persons not citizens of the United States are debarred entirely.

On the whole, the cattle brought from the plains dislike the mountains, and in many cases require to be kept there, either by fences erected across the valleys or by herders, whose duty it is to drive them back, keep them scattered, and salt them. By far the greater part of the cattle in the reserves are not herded; they are merely turned loose in the mountain parks and prairies, salted at regular intervals, and otherwise left without care or protection.

The cattle prefer the open parks, usually along the creeks; they dislike the denser woods, rough and steep ground, and high elevations.

They feed chiefly on grass and refuse weeds, and take little browse (except in some of the southern reserves). Cattle feed less closely than sheep, and being free, each animal travels only when it wants to, mostly to and from water. They use much less of the entire area of the reserve, and take only a portion, often the smaller portion, of the feed.

That cattle do no damage at all, as is so often claimed, is not true. Cattle cut trails on all hillsides, particularly in the vicinity of water. They are filthy about watering places, standing often for hours in and about the water and trampling many springs into unsightly mires; occasionally they browse; they bark trees by rubbing, and they naturally trample seedling trees, just as any other animal would. Being loose footed, there should be less trampling; but this is not always the case, since cattle by their very laziness are apt to stay more persistently on any given small area. That cattle do less harm to the range is only partly true. They crop it less closely, but choosing only grass and leaving the weeds, many a cattle range has been changed into a "weed patch." That overgrazing and consequent increase of all injuries is possible with cattle as with sheep is self-evident, and has been fully established on a number of ranges.

Numerous suggestions have been made for the restriction of grazing in the forest reserves. The most urgent and weighty of petitions of this kind come from the farmers in the vicinity of the reserves, who see in these mountain forests the protection for their all-important water supply. These petitions are fully considered each year in the allotments, and whenever the presence of sheep or cattle in these mountains appears to seriously endanger important agricultural interests it is but natural that the principle of the greatest good to the greatest number should prevail.

For a better regulation of the grazing, it has been suggested that, at least for sheep, and preferably also for cattle, the ranges be subdivided as far as the mountainous character of the reserves permits, and that each stock owner be allotted a well-defined range. This, as was correctly pointed out several years ago by Mr. Frederick V. Coville, Botanist of the Department of Agriculture, in his bulletin on the grazing in the Cascade Reserve of Oregon, would induce the stockman to care for his range, to protect it against fire, and to improve it by seeding or otherwise, and would prevent heedless overgrazing.

To carry out such a system would entail considerable additional expense upon the Government, and it has therefore been suggested that a per capita tax or rental should be imposed on all stock grazing in the reserves.

Though there is still considerable opposition to such a system, it may be said that nearly all of this opposition to-day does not come from the resident, permanent stockmen, but comes mostly from men who run stock wherever there is open range, avoiding all responsibility and owning little outside of their herds.

AGRICULTURE IN THE TROPICAL ISLANDS OF THE UNITED STATES.

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INTRODUCTION.

The tropical territory under the governmental control and within the scope of the commercial influence of the United States is an extremely small fraction of the land surface of the Tropics, but it is large enough to furnish a field for much of the American enterprise which formerly found an outlet in the Tropics under foreign flags only; it is also large enough and has sufficient natural diversity of climate and soil to produce nearly all our tropical imports, the annual value of which is about $200,000,000. As the United States is now by far the largest consumer of such products, there is no obvious reason why American interest in the agriculture, commerce, and social progress of the Tropics should remain second to that of any other nation. Americans, it is true, lack the long practical experience enjoyed by some of the European countries; on the other hand, pioneering and missionary instincts have continued from colonial times to lead Americans to the West Indies, to the "Spanish Main," and to the East, so that, as a nation, they can hardly be considered strangers in the Tropics. Valuable knowledge has been gained by individuals and firms, but it has remained local and private. We may, however, be able to compensate for lack of acquaintance with the traditional procedure in tropical agriculture by promptly recognizing and practically applying the scientific discoveries of the last decade.

IMPROVEMENT OF HEALTH CONDITIONS IN THE TROPICS.

Hope for the development of tropical resources along agricultural and other lines has recently taken on new strength through the discovery of a microscopic organism. It is now known that the air of the fairest and most fruitful regions of the earth is not charged with a "miasma" or subtle poison calculated to attack with special virulence the stranger from the North. The mysterious terror of the centuries is not even a mosquito, but the parasite of a mosquito. To compare this infinitesimal creature to the traditional millstone would be but a mild figure of speech. In all tropical countries of low elevation, except some of the Pacific islands, where the mosquito is unknown,

malaria has sapped the life of man and hindered his progress, and in many regions it is a veritable scourge and pestilence, only less terrifying than cholera and other epidemics, chiefly because of its constant presence.

The knowledge that malarial infection is due to the bites of mosquitoes does not abolish the malaria, the mosquitoes, or their dangerous parasites, but it enables us to protect ourselves, and shows us that the difficulty can be overcome, in some regions very easily. In short, the discovery of the parasite of malaria is a more important factor in the progress of the Tropics than any other knowledge drawn from previous human experience in those regions. The entomologist, the drainage engineer, and those who make mosquito-proof houses and beds now hold, as it were, the keys of many paradises which civilized man has thus far been unable to inhabit or even to exploit.

Yellow fever has also yielded to investigations following the analogy of malaria, and numerous other tropical diseases are now being subjected to systematic and persistent research by modern methods. Nor will this research stop with the diseases of man and the domestic animals. The science of plant pathology, which saves millions of dollars annually to the farmer of temperate regions, may be brought to the assistance of tropical agriculture, and with every prospect of even more prompt utility, in view of the knowledge and skill already developed in investigating the diseases of temperate plants.

IMPORTANCE OF PLANT VARIETIES.

The study of plant diseases has also greatly increased the appreciation of the importance of varieties. It costs no more to cultivate a vigorous plant, or one which yields a product of high grade, than one which is sickly and stunted, or yields an inferior crop, and the difference between these is often merely that of the variety planted. It is highly probable that this matter of species and varieties, which are closely similar externally but widely different in their internal functions and products, is the key, or at least one of the keys, to the important and much-debated question of rubber cultivation. Trees are, in all countries, difficult subjects for botanists, and those of the Tropics are largely known only from small herbarium fragments, and are consequently especially difficult to recognize amid the tangled vegetation of the forest. If, therefore, botanists are still finding new species of oaks, hickories, and elms in the Eastern States, rubber planters should realize that it is but a reasonable precaution to reject the judgment of botanists, promoters, and natives, and insist on having seeds and cuttings from trees which have actually yielded rubber of good quality in paying quantities. To depend on the popular notion that a rubber tree is a rubber tree, to believe that some rubber trees

will produce in a certain locality because others do, or that a good variety will be equally good in all localities, is to recklessly take chances of failures which no zeal in other directions can prevent.

SPECIAL METHODS OF CULTURE AND CURING.

That the question of quality has generally failed to receive adequate consideration in the tropical agriculture of the past is well shown by the fact that, although the coffee of some countries is two or three times as valuable as that of others, we are still in ignorance of the factors which influence quality, whether it be the variety, the rainfall, the sun or the shade, the ripeness, the fermentation, the drying, or the curing. There are some opinions on the subject, but they are widely at variance, and are generally supported only by local and superficial reasons.

With coffee, as with tobacco, cacao, and vanilla, processes of curing or fermentation influence the formation of the particular chemical compounds for which these products are valued, and though the necessary treatment may be simple, the proper application of it may require special knowledge and the skill which comes only as the result of experience and long practice. It may accordingly be believed that the development of methods and machinery for meeting these and similar requirements will exert an important influence on the development of tropical agriculture. Instead of conducing merely to the centralization of productive industry, as in the case of sugar, the existence of establishments for carrying on the manufacturing side of tropical agriculture will also make possible, as never before, the development of mixed farming in the Tropics, and will render relatively unprofitable the policy of mere exploitation, which has been characteristic of so many tropical enterprises. It will be possible for the farmer to devote himself more definitely to the work of production, and by diversifying his crops and adapting them to the climate, seasons, and other conditions, he will be able to compete successfully with enterprises which confine themselves to one specialty, and which, in many cases, import from abroad even the staple foods consumed on the plantation.

Thus, within the Tropics as well as in the temperate regions, the improvement and diversification of products and their uses will continue with increasing rapidity, made possible by the modern facilities of transportation which will certainly be a distinctive feature of all agricultural communities in which American interests are involved. A visit to the Tropics will ere long become as common a diversion for Americans as a trip to Europe, also as instructive and enjoyable, and residence in the Tropics for the whole or for a part of the year will no longer be deemed a hardship, but will become a matter of personal preference for thousands of our citizens.

MISTAKES OF ENTERPRISES IN TROPICAL AGRICULTURE.

In considering the starting of new agricultural industries it is necessary to remember that, notwithstanding the great importance and conspicuous success of many pioneer enterprises in the Tropics, the majority of them meet with more or less serious losses. Even with undertakings of excellent possibilities there are often failures, at first, for reasons that it would have been difficult or impossible to foresee. There are, however, some general requisites of success, the neglect of which often causes avoidable disasters.

The need of favorable climate, good soil, cheap transportation, and ready access to market is generally self-evident, though errors are frequently made through lack of familiarity with tropical or local conditions. Even where conditions are favorable, and where care and diligence have merited success by overcoming cultural difficulties, regrettable disappointments occur. Individual planters often try important experiments in the production of new crops, but though successful in the field they may meet with loss in the market, because the export merchants often refuse to handle an unfamiliar article, or, if they forward it to Europe or the United States at the expense of the grower, they do not take the trouble to find it a place in the market or even to bring it to the attention of those who might be able to give an authoritative opinion regarding its quality. Commercial failure may thus neutralize agricultural success; the planter has his labor and expense in vain, his experiment is discredited with his neighbors; the attempt is abandoned, and similar undertakings avoided. Such instances afford no argument against intelligent experiments, but they illustrate the point that the work of establishing new agricultural industries has a commercial side which must not be left out of account either in planning or in executing such undertakings.

ACCESS TO MARKETS.

In being already occupied by considerable populations of civilized peoples, our tropical islands differ notably from the regions in which Americans have for so many generations done pioneer work along agricultural lines. One great advantage of this is the existence of local markets for food products for which no profits could be obtained in the uncivilized countries where many attempts have been made to establish European colonies. In Porto Rico, for example, the prices of garden vegetables average well above those of our city markets, and the quality is generally inferior. Accordingly, Americans who have been able to produce superior vegetables have not been compelled to wait for export facilities, but have disposed of their crops within a few miles of their farms. This is an important advantage for the planter of small capital, and will greatly assist in the substitution of

mixed farming in our tropical possessions for the mere exploitation of a single crop, to which latter system the continued backwardness of many regions endowed with great natural resources has been very justly ascribed.

The agricultural development of such an island as Porto Rico should be sought on lines which do not, on the one hand, involve competition with already existing subtropical industries and which do not, on the other hand, throw away the enormous advantage of easy access to our Eastern markets, from which Hawaii and the Philippines are so remote. Tropical fruits are being shipped, it is true, from Bombay to London, but this is not a reason why mangoes and bananas for our markets should be grown in the Philippines rather than Porto Rico, nor why Porto Rico should be encouraged to specialize on sugar and cacao, when it can furnish tropical fruits at our door. Porto Rico should not stake too much on the possibility of being able to compete with the oranges of Florida and California in the regular season when by proper choice of varieties and cultural methods it should be possible to obtain an earlier crop than these States can grow; and neither should Porto Rico be encouraged to send to our markets indifferent oranges which will sell for 15 to 20 cents a dozen when the island could as readily produce first-class alligator pears, for which we now pay 30 to 50 cents apiece, to say nothing of the mangoes which sell at eight and ten for a cent on the south side of Porto Rico, while the far inferior fruit brought to the United States from Jamaica is held here at "three for a quarter."

PROMISING CROPS.

The Department of Agriculture receives many letters from purchasers of tropical lands who desire to be told which is the most profitable crop they can plant on them, how to cultivate the same, what the profits will be, when the profits will be realized, and other particulars of the same kind. These correspondents fail to realize that, however different in crops and cultural details, the agriculture of the Tropics resembles that of temperate regions, at least to the extent that large profits depend upon favorable natural conditions, skillful and industrious farming, adequate and cheap labor, accessible markets, good prices, and numerous other contingencies. The most important difference between agriculture in the Tropics and agriculture in temperate regions does not lie in the greater security or larger profits of tropical agriculture, but in the fact that the attendant difficulties, being less known, are less easily anticipated and less easily overcome. It is true that the profits of successful tropical agriculture are sometimes very large, but it is also plain that this would not be the case if the art by which they are obtained were as easy as often supposed.

It is not difficult to find regions in the Tropics where there are no frosts, droughts, potato bugs, or Hessian flies, but it does not follow that all seasons will be favorable or all crops sure and profitable. Other obstacles, pests, and losses should be expected, and the first months of tropical residence may well be devoted to the accumulation of experience with new plants and new agricultural conditions. Familiarity with the crops and methods of one's neighbors, however primitive, is well worth the trouble of securing, and will afford local knowledge of much value in dealing with any special cultures which may be undertaken. At the same time it is eminently desirable for the grower to widen as rapidly as possible his acquaintance with the plants which may be utilized in his locality, and to settle upon those which seem most promising from the commercial standpoint.

ALLIGATOR PEAR.

The alligator pear, also called butter pear, aguacate, and avocate, is a tropical fruit now relatively little known, but with every prospect of a gradually increasing popularity. It is a pear only in shape, and might better be compared to the olive, because it serves as a salad or a relish rather than a fruit in the ordinary sense, and frequently becomes a favorite, even with those who do not like it at first. The flesh has a delicate buttery consistency, and is eaten with vinegar, salt, and other condiments, or is used as an ingredient of other salad compounds. The promise of agricultural and commercial importance for this fruit lies in the fact that it already has a distinct, if limited, place in the markets of our larger cities at from 30 to 60 cents apiece, prices which might be halved or quartered and still leave good profits for both grower and dealer. Moreover, even at these large prices the supply of first-class fruit seems to be unequal to the demand.

The alligator pear is perhaps the one fruit which Porto Rico is ready to send to market in considerable quantity and of prime quality. The tree is easily propagated from seed, is a vigorous grower, and a free bearer, and there is no apparent reason why the alligator pear may not become almost as cheap and nearly as popular as the orange. (See Pl. XL.)

BANANA.

The banana may well be reckoned as the most important of all fruits, since it is one of the principal food staples of many millions of the inhabitants of the Tropics, and is also exported to temperate regions in rapidly increasing quantities, far exceeding in amount and value any similar product. The people of Porto Rico are especially dependent on bananas, which, though grown and eaten in large quantities, are not exported, so that Porto Rico receives nothing for bananas consumed in the United States, though $5,000,000 is paid annually

ALLIGATOR PEAR FROM PORTO RICO (NATURAL SIZE).

DWARF BANANA.

to Jamaica and Central America. The soil and climate of Porto Rico appear to be in every way suitable for banana culture, and in early days the superiority of Porto Rican bananas was noted. Owing, however, to cultural neglect, partly due to the general use of the banana for coffee shade, the varieties now in Porto Rico are mostly inferior in quality and productiveness, and worthless for export. It is even uncertain whether the so-called Jamaica banana exists in Porto Rico, though there is a variety which is, at least, closely similar. In addition to the growing of a good variety, the opening of export trade would require production on a sufficiently large scale to secure advantageous shipping facilities, and a special effort may be needed to introduce the Porto Rican bananas to our markets unless the organized fruit trade can be induced to take an interest in the development of the island. For the future of banana culture the question of varieties is of the greatest importance, since there are even greater differences than among apples and pears. The American public is familiar with but one variety, which has been preferred in cultivation on account of its vigor and productiveness, and not because of its quality, as this is mediocre at the best.

The distress and starvation which follow a hurricane in Porto Rico on account of the destruction of the bananas could be largely avoided, as in the Fiji and other Pacific islands, by the general planting of bananas of the dwarf type, with trunk from 4 to 6 feet high, instead of from 15 to 20 feet. (See Pl. XLI.) The dwarf banana is planted but sparingly in Porto Rico, owing to the inferior quality of the fruit of the only variety of this type now known in the island. There are, however, other dwarf sorts of a quality much superior to the large-trunked Jamaica banana, and not lacking vigor or productiveness, though possibly requiring somewhat more care in shipment. This latter feature would be an advantage rather than otherwise for Porto Rico if the new variety were to attain popularity in our markets.

CACAO.

The culture of the cacao tree, from the seeds of which chocolate is made, was an important industry among the natives of Guatemala and southern Mexico before the advent of Europeans. The Spaniards found the new food beverage very acceptable, and from that time to the present there has been a gradual increase of popularity with no present indications of a limit being reached, unless through popular disgust with extensive adulteration. Unsettled political conditions have frequently interfered with the prosperity of cacao-growing regions and prevented the natural expansion of the industry, so that consumption has often been limited by high prices. Thus, although the culture of cacao is an old industry, it is still one of the most

promising branches of tropical agriculture. It is also one in which there is room for much improvement in the choice of varieties, in methods of culture and preparation, and in the treatment or prevention of parasitic diseases, in all of which an intelligent and progressive community will have a distinct advantage over the backward regions which now produce most of the cacao of commerce. In the way of caution, it may be noted that while cacao was formerly, and may again be made, of some agricultural importance in Porto Rico, the growing of cacao as the only resource of the planter can not be advised, since this crop is especially liable to loss through hurricanes, owing to the fact that the large fruits are borne on very slender stems, which rise directly from the old wood, and are thus very easily broken off and destroyed.

The Philippines should be the better field for cacao, not only because of the larger extent of probably suitable land, but also because the relatively high value of cacao renders the cost of shipment proportionally much less than with sugar and other cheaper and more bulky products. Cacao has long been cultivated in the Philippines, though it is not known that care was taken to introduce superior varieties. Some of the Philippine cacao is said to be of good quality, but it seems never to have been raised in large quantities or to have become an article of export in competition with the cacao of Spanish America. (See Pl. XLII.)

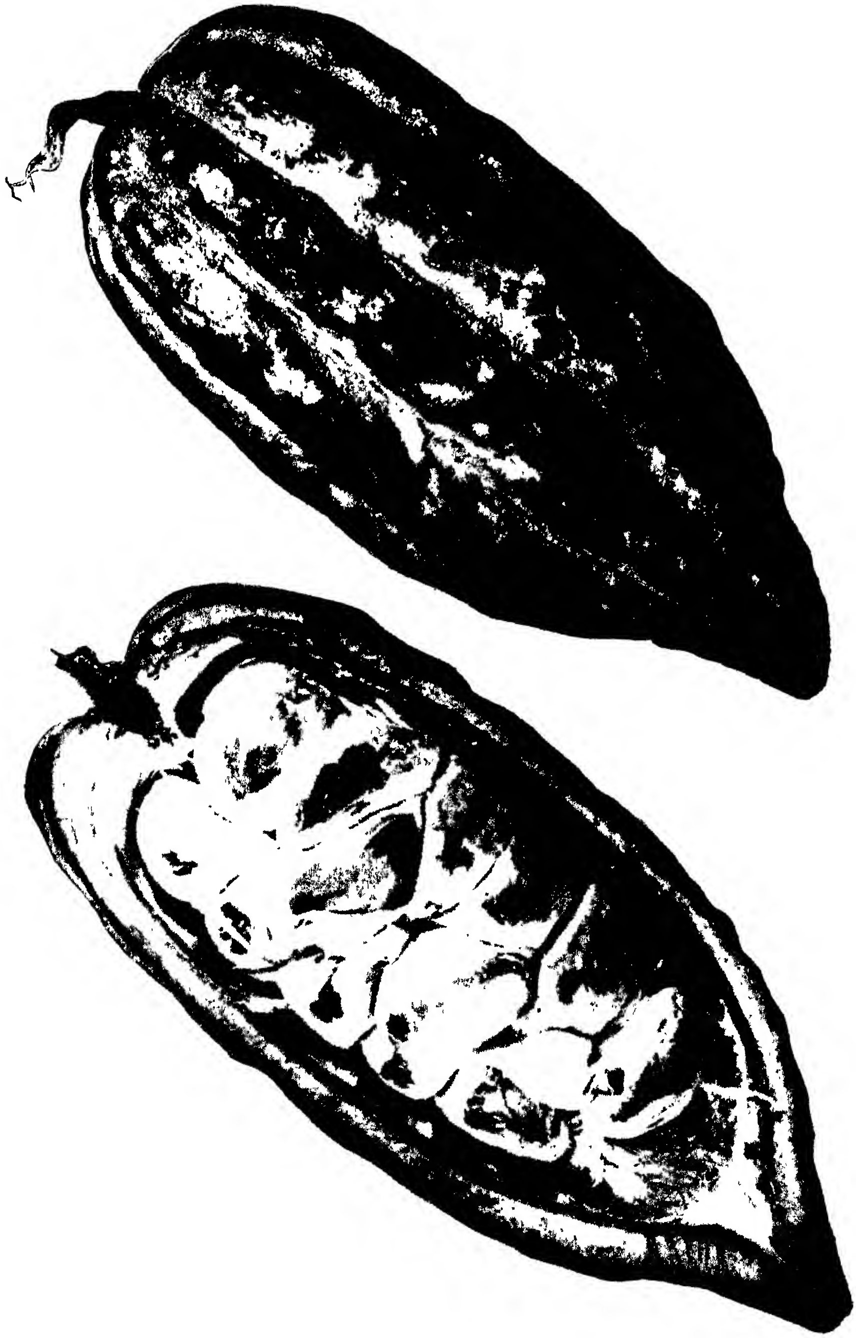
CAMPHOR.

Northern Luzon is the geographical neighbor of Formosa, the present center of camphor production. The camphor tree is relatively hardy and easy to cultivate, and has been planted in considerable numbers as a shade tree in the Gulf region of our Southern States, though it is still uncertain whether the commercial production of camphor is practicable in this region. In Algeria it has been found that although the trees appear to thrive, they contain little gum. In Luzon, and probably also in Porto Rico and Hawaii, the planting of camphor on lands unsuitable for general agricultural purposes is eminently worthy of consideration. It is, indeed, at the present time, a safer industry than rubber culture, since camphor can be grown in drier and more wholesome localities, and since the crop is less likely to be a total failure.

CASSAVA.

The most important of the tropical root crops is the cassava,[1] from which tapioca is made, and from which a superior quality of starch

[1] The culture, properties, and uses of the sweet cassava are discussed in Bul. No. 44, Division of Chemistry, U. S. Dept. Agr.



CACAO PODS (NATURAL SIZE).

COFFEE DISTRICT BETWEEN PONCE AND ADJUNTAS, PORTO RICO.

can be obtained very cheaply. Although poisonous when raw, the thick, fleshy roots furnish wholesome and palatable food when cooked. Some varieties are without noxious qualities, but are considered less productive. The yields are in some cases enormous, 12 tons and upward per acre having been claimed. Cassava should not remain unknown to any tropical agriculturist; certainly not to those who have laborers to feed.

CHAYOTE.

Porto Rico already produces in abundance a tropical vegetable for which a little persistence might create an export demand in the United States. This is a member of the squash family, called the chayote in its native country, Mexico. It is rapidly becoming popular as a winter vegetable in Paris and London, whither it is shipped in large quantities from Algeria. The chayote is worthy of a place in every tropical garden, and should be introduced into both the Hawaiian and the Philippine islands. It has a variety of domestic uses and is very easy to cultivate. It would have been widely known long since but for the fact that the fruit contains but a single seed, and must be shipped and planted whole, because the seed is soft-skinned and dries up if extracted.[1]

CINCHONA.

The culture of the cinchona tree, from the bark of which quinine is extracted, has become an industry of considerable importance in India and Java, although the various species of cinchona are all natives of the mountains of South America. The mountainous regions of the southern Philippines may afford conditions favorable for the culture of cinchona, but private planters of small capital can scarcely hope to maintain competition with the enormous estates of the governments and syndicates of the English and Dutch colonies, although even at the present low prices of quinine the profits are still said to be very large. The extraction of the alkaloid from the bark is a manufacturing process of some complexity, which also favors production on a large scale.

COCA.

The coca plant, from which the important medicinal alkaloid cocaine is extracted, is a native of the Andes of South America, where millions of the natives have the habit of chewing the leaves. Coca could, perhaps, be grown at high elevations in Hawaii or in Luzon, or, perhaps, in some of the frostless valleys of California, but such an industry must of necessity compete with the cheap labor and long experience of the South American Indians, who have a large home market, and who export to Europe and America only a small surplus.

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[1] The chayote and its culture and uses have been described in Bul. No. 28, Division of Botany, U. S. Dept. Agr.

COCOANUT.

The cocoa palm is certainly the most characteristic object of the Tropics, and its beauty is equaled only by its utility among tropical peoples. In commerce it appears in three forms. The fresh nuts are shipped to Europe and America for eating or for use in desserts and confectionery; the dried meat is marketed under the name of copra for the extraction of the oil, and the fibers of the husk are sold as coir, and used in the manufacture of brushes and coarse fabrics. Although the cocoa palm exists in large numbers in Porto Rico, few nuts are exported and no copra or coir is made. Nearly all the nuts are picked while still green, and are bought in the cities and towns for the sake of the milk, which is the most popular beverage of Porto Rico. Copra and coir come largely from the Pacific islands and the East Indies, and both are prepared by natives in their leisure time, though machines and improved processes for extracting the fiber have been invented.

COFFEE.

Contrary to popular impression, the chief crop of Porto Rico is not sugar nor tobacco, but coffee, the exports of which have in some years been of more than twice the value of all other products taken together. Moreover, a majority of the people of the island are more or less directly dependent upon the coffee industry, the decay of which would mean the continuation of the distress which resulted from the conjunction of low prices, disturbed trade, and the hurricane of August, 1898. Fortunately, the natural conditions appear to be very favorable, not only for the maintenance of the present acreage of coffee, but for a still further extension of the industry, which, with the popularization of better methods of culture, would enable Porto Rico to take rank as an important coffee center. It would be entirely feasible for the island to produce one-third or even one-half of the enormous total of 800,000,000 pounds consumed yearly by the people of the United States, now imported almost entirely from foreign countries at an annual expenditure of from $60,000,000 to $100,000,000.[1]

Although greatly subordinate to sugar, coffee culture is also established in Hawaii and in the Philippines, and with favorable conditions, so that there are no natural obstacles to the production in American territory of all the coffee required in our market.

The most conspicuous cultural problem of coffee growing is the much controverted question of shade, a preliminary report of an investigation of which has recently been published.[2] It seems suffi-

[1] In 1892 over $128,000,000 was paid for coffee; in the calendar year 1901 over a billion pounds was imported. (See Bul. No. 27, Section Foreign Markets, U. S. Dept. Agr.)

[2] Bul. No. 25, Division of Botany, U. S. Dept. Agr., "Shade in coffee culture."

COFFEE BERRIES FROM PORTO RICO (NATURAL SIZE).

SUGAR PLANTATION NEAR CAROLINA, PORTO RICO.

ciently obvious that shade is no direct nor normal requirement of the coffee plant, and that the root tubercles of the leguminous trees generally planted for shade may contribute to the fertility of the soil. Other possible advantages doubtless lie in protection against drought and in the moderation of the temperature of the superficial layers of the soil, but the relative importance of the different factors can be determined only by careful experiments.

Coffee is the most important tropical crop grown in salubrious elevated regions. The climate and natural scenery of some of the coffee districts of Porto Rico are magnificent, a fact which would doubtless have had greater weight with American investors had they not been discouraged by the distress from which the native planters have recently suffered. (Pls. XLIII and XLIV.)

DATE.

Date culture is a promising industry in the hot alkaline deserts of Arizona and California, but it has little prospect of commercial success in any of our tropical possessions, for although the trees do not refuse to grow, the fruit does not attain proper maturity except in hot desert climates.[1]

MANGO.

The mango stands in the highest rank of tropical fruits (that is, the better varieties of mangoes), but some of the inferior sorts have been appropriately described as a mixture of tow and turpentine, because of the fibrous flesh and the resinous taste. Few Americans have seen any except the latter type, since the mangoes which reach our markets are entirely of this class. They are handled by fruit dealers merely as "novelties," and are bought by those who wish to know what a mango is like, but who generally conclude that they are worse than worthless. The difficulty of producing good mangoes lies largely in the fact that, as with the apple, the varieties do not come true to seed, but must be propagated by grafting, which, with the mango, is generally reckoned a rather difficult process, though it is now believed that the difficulties have been greatly overestimated.

The mango is a native of India and has received the largest amount of cultural attention in that country, where hundreds of choice varieties are known. Some of these are said to have reached the Philippines, but no attempt seems to have been made to bring them to Porto Rico, where chance-sown seedlings are depended upon for the perpetuation of the species. Aside from the varietal inferiority, the mangoes of the south side of Porto Rico are excellent, and there appears to be no doubt that the natural conditions are entirely favorable for the growing of this fruit to perfection.

[1] Yearbook U. S. Dept. Agr., 1900, "The date palm and its culture," by W. T. Swingle.

MANILA HEMP.

This important fiber is extracted from the leaf bases of a species of banana, the fruit of which has large seeds, and is dry and inedible. It is a native of the Philippine Islands, to which the commercial production of the fiber is still confined, in spite of numerous attempts at introducing the industry into other tropical countries. These failures in producing the fiber elsewhere have probably been due quite as much to the lack of the skill possessed by the Philippine natives in extracting the fiber as to the refusal of the plant to thrive in other regions; and until machinery can be made to replace hand labor there is little prospect of any great change in present methods of production. There is every reason to expect that the industry will repay careful attention from agricultural, commercial, and manufacturing standpoints, but at present the steady and gradual improvement of conditions and methods of production is the only general policy which can be safely recommended. The various fiber industries have been the fields of many inventions and a great number of schemes and devices, the essential impracticability of which appears only under the test of commercial production.

Manila hemp long held the first place among the exports of the Philippine Islands, and the value of the export far exceeded the total value of all other articles except sugar. The quantity of manila hemp which came to the United States was also large and increasing, since improvements in harvesting machinery have rendered the United States the principal consumer of fibers of the class to which manila and sisal belong. The recent disturbances in the Philippines have greatly reduced the supply of manila hemp, and the sisal industry is enjoying a corresponding period of prosperity. The longer the Philippine fiber remains scarce the greater and more permanent will be the extension of the uses of sisal.

OLIVE.

The olive is a native of the arid Mediterranean region, and seldom, if ever, fruits in the moist Tropics. Suggestions that it be planted in Porto Rico and the Philippines are therefore ill-advised.

ORANGE.

While it is true that oranges and other citrus fruits can be grown in almost all regions where tropical agriculture is carried on, it is also true that at present but a small part of our commercial supplies of these fruits comes from the Tropics. Citrus cultures in the Tropics are accordingly still somewhat experimental, and the commercial production of high-grade fruit will remain uncertain until demonstrated by facts. Formerly there was no attempt in Porto Rico at orange growing as understood in Florida, the fruit of seedling trees supplying the local demands.

It will probably be found that some localities on the north side of Porto Rico are too wet for raising oranges, and orange culture by irrigation in some of the more arid limestone districts of the south side may possibly be worth considering, in view of the fact that the prices of the Porto Rican fruit will depend largely upon the earliness with which it can be brought to market. The season opens now in November, but a month or more may be gained by proper methods of culture and the planting of early varieties.

PINEAPPLE.

The pineapple is a native of the American Tropics, and the pineapples of Porto Rico have been noted for size and quality since the sixteenth century. One of the largest varieties, called by the Porto Ricans "cabezona," is in Florida and elsewhere called the "Porto Rico." Pineapples grow wild, or nearly so, in almost all parts of Porto Rico, so that for home consumption little in the way of regular cultivation is necessary, and under former political and commercial conditions the shipment of fruit to the United States was difficult, if not impracticable. At present, therefore, when the culture of the pineapple is being seriously taken up for the first time, there is a lack of experience and the same scarcity of good cuttings that might be expected in a country to which the plant was new.

As with many other fruits, the finest varieties do not go into trade, and the favorite pineapple of Porto Rico, the "pan de azucar," or "sugar loaf," is of too juicy a texture and decays too quickly to withstand shipment like the more acid, woody type common in our Northern markets.

In Florida, a new departure in pineapple culture has been made through the discovery that the lattice-work sheds built for protection against frost also exert a notably beneficial effect upon the size and quality of the fruits, supposedly through the medium of the partial shade. Accordingly, the building of sheds at an initial expense of from $200 to $300 per acre is now being practiced far to the south of the frost line. Whether similar measures are necessary to the best results in Porto Rico, and whether they can be attained by the substitution of shade trees like the saman (Pithecolobium) or other loose-foliaged leguminous species, commonly planted with coffee, are cultural questions which remain to be investigated.

PERFUME PLANTS.

The tropical plants from which perfumes and other essential oils are derived may be made the basis of minor agricultural industries, but production on too large a scale may render such cultures entirely unprofitable. Bay rum has long been an article of export from Porto Rico, the oil being obtained by distilling the leaves of a small tree, the

"limoncillo" or "malagueta" (*Amomis caryophyllata*), native in Porto Rico, the Danish West Indies, and some of the neighboring islands. The present supplies are derived from wild trees, but cultivation would be easy and inexpensive, since the tree flourishes on rocky hill-sides worthless for general agricultural purposes.

On the south side of Porto Rico the so-called "aromo" (*Acacia farnesiana*) covers many square miles of waste land. This same shrub is known as "cassie" in the south of France, where it is extensively grown for the sake of the perfume of the same name extracted from the flowers. The latter when properly dried have also a market value as an ingredient of sachet powders.

The Philippines have preeminence in the production of ylang-ylang, a perfume highly valued in the Orient as well as in Europe. The ylang-ylang oil of the Philippines is considered superior to that of the Asiatic Continent, and the higher grades command fancy prices—$50 per pound and even more. The present supply is said to be unequal to the demand, and estimates of large profits from ylang-ylang plantations have been made.

RICE.

Rice is the only tropical cereal of the first rank, and is a staple article of food even in many tropical regions where it is not grown. Rice for home consumption is raised in all of our tropical islands, and large amounts are also imported. In Porto Rico only highland rice is planted, while in the Pacific islands the industry is entirely in the hands of natives and Chinese, who follow the laborious method of transplanting each individual seedling. On these lines rice culture will hardly be a subject of much interest to the American planter, but it remains to be seen whether the new methods which have recently given rice culture such an impetus in Louisiana and Texas can be applied in the Tropics. Instead of using swamps, the rice is planted on firm prairie land, where the crop can be planted and harvested with the aid of modern farm machinery, though flooding by irrigation will be necessary during the growing period.[1]

RUBBER AND GUTTA-PERCHA.

Popular interest in tropical agriculture is at present largely monopolized by the possibilities of rubber culture, as set forth in glowing descriptions in various prophetic calculations and in the prospectuses of numerous companies which have been formed for establishing rubber plantations in Mexico and Central America. Some of the representations are made with every evidence of reliability and good

[1] Rice culture, including the Louisiana rice industry, has been described by Prof. S. A. Knapp in Bul. No. 22, Division of Botany, U. S. Dept. Agr.

faith, but their credibility naturally suffers from the no less obvious fact that many others are directly calculated to deceive the unwary investor. Moreover, it is known that many rubber plantations established with the most lively expectations have been abandoned because the anticipation of a profitable yield of rubber from cultivated trees proved to be fallacious.

Similar disappointments, misapprehensions, and misrepresentations have, of course, marked the early history of many finally successful and important industries. Such facts simply show that whatever may be its future, rubber production is not likely to be better able than other lines of agriculture to dispense with knowledge and discrimination.

Many of the current misconceptions regarding rubber culture result from the popular failure to realize that rubber is not like coffee, tea, or cacao, the definite product of a single species or genus of plants; rubber should be compared, instead, to starch and sugar, substances obtainable from large numbers of plants of different types, botanical and cultural. It has been estimated that 1,000 different species contain rubber, though commercial quantities have probably been obtained from only 40 or 50. The sugar cane, the sugar beet, and the sugar maple involve very distinct cultural problems, to which no general principles will apply, and the culture of the different rubber plants must be dealt with on an equally individual basis instead of through fallacious general principles. Thus far, we have little certain knowledge even regarding the identity of the plants, and the traditional rubber tree of Para has recently been described as a new species and found to be quite different from the *Hevea brasiliensis* with which it has so long been confused. A European investor who might come to New England to raise maple sugar, and who should plant his orchard from wild stock before finding out that there is more than one species of maple, or that the different species require different conditions, would not be more reckless than some of the rubber companies; nor, if he proposed to pay the expenses of the enterprise from apples and other fruit trees planted in the sugar bush and leave the sugar as a clear profit, would his agricultural ideas be more crude than those of some of these companies. In short, rubber culture is a very complex problem, which has not yet received the detailed investigation necessary to place it on a scientific and practical basis.

Notwithstanding widespread interest and the investment of millions of dollars, it can not be said that rubber culture has passed the experimental stage, if, indeed, that period has been fairly reached.

The extent to which these so-called possibilities of rubber culture have inflamed the imagination of some is well illustrated by their advocating the culture of *Eucommia ulmoides* for the sake of the gutta-percha.

Eucommia is a native of central China, and the idea of a gutta-percha tree which could be grown in the temperate regions of Europe and America promised to be especially attractive, and has been extensively advertised by the dealers in such seeds, who apparently have not undertaken to ascertain the rate of growth of the tree, and who fail to state that among the Chinese it is planted for its bark, which is valued as a medicine and brings about the same price ($1.50 to $2) per pound as gutta-percha, of which it contains about 3 per cent. On this basis, gutta-percha would need to be worth $60 a pound before the culture of Eucommia would become profitable.

SISAL HEMP.

Among the current suggestions for new tropical crops is that of sisal hemp. This is a product of an agave or century plant, and is now largely imported from Mexico. It is, however, improbable that any large area of Porto Rico could be profitably devoted to growing this plant, the culture of which finds a place in soil which is too dry and rocky for ordinary crops, and consequently of so little value that it can be given up to a rather slow-growing plant like the agave. Three or four years are required before the cutting of the leaves and the extraction of the fiber may be begun. The business can be carried on to best advantage on large estates, those of Yucatan and German East Africa being from 500 to 20,000 acres or more in extent.

The dry southern slopes of Porto Rico may afford suitable conditions for sisal hemp, but most of the country is so mountainous and broken as to make difficult even the slight cultivation necessary for the agave. The roughness of the country would also render it much more expensive than in Yucatan to construct the tramways for bringing the fresh leaves to the factory. These are as necessary as in sugar plantations; but in some localities it might be possible to substitute overhead cables for surface tracks.

If the present prices could be maintained sisal would undoubtedly be a very profitable industry, since the fiber is now quoted at 7 and 8 cents per pound, while in former years from 3 to 5 cents were usual prices. The present high figures are due to the scarcity of manila hemp and to the increased use of binding twine. The demand is likely to continue, and it will require several years, at least, for manila hemp to regain its place in the market. Favorably located plantations of sisal in Porto Rico or Hawaii may remain permanently profitable; others might suffer from the natural extension of the industry in Yucatan or other communities where large tracts of nearly level desert land can be utilized at small expense.

SPICES.

Owing to the necessarily limited demand, the spice-growing industries are especially liable to overproduction and great fluctuation in

prices. For food staples and other articles consumed in large quantities there are permanent markets, but when the normal trade requirements of special products have been filled, the surplus of even a normally high-priced article may not be worth taking, and in the Dutch East Indies it was deemed good policy to burn up spices representing thousands of dollars rather than send them to Europe to flood the market, to the permanent detriment of the industry.

The opening of new regions of production is therefore to be undertaken only when the conditions are really favorable, and when the enterprise has sufficient financial backing to survive the period of overproduction and drive the competing districts out of the business. Thus, in recent years the East African islands, Pemba and Zanzibar, have become the chief centers of clove production, while the industry is dying out in Amboina and Penang. In nutmegs, the small West Indian island of Grenada has become a formidable competitor of the even smaller Malayan islands of Banda, which long enjoyed an almost complete monopoly. Pepper is still confined commercially to the Malay Peninsula. In ginger, the traditional supremacy of Jamaica is not in serious danger, because the superior grade for which the island is famous is all scraped by hand in the leisure time of a poor but self-supporting population, with which a similar industry dependent upon hired labor could scarcely compete.

While it is thus impossible as yet to advise that the culture of spices be undertaken on a large scale in Porto Rico, Hawaii, or the Philippines, residents of promising localities should be encouraged in experimental planting, with the expectation that such crops may become useful accessories in the development of rational systems of mixed farming, so greatly needed in the Tropics.

SUGAR.

Sugar is the largest agricultural industry of the Tropics, and is by far the largest agricultural import of the United States, notwithstanding our extensive domestic cultures of sugar cane and sugar beets. Sugar production is an industry of the factory almost as much as of the farm, and as a manufacturing industry it can not be economically conducted on a small scale. A half million of dollars is now considered little more than a minimum investment for establishing a modern sugar plantation and mill, and the smaller enterprises of individual planters are being rapidly absorbed or combined into stock companies by large capitalists, or are compelled to leave the business of extracting the sugar, merely selling their cane to the mills. In Porto Rico many of the less accessible estates have been abandoned for several years, while in the neighborhood of the large modern factories, or centrales, there is abundant prosperity. (Pl. XLV.)

As might be expected with an industry requiring so much capital, sugar growing is on a much more scientific basis than other agricultural industries of the Tropics, though many improvements undoubtedly remain to be made. The most striking recent advance has been in the line of new seedling varieties bred in the British West Indies and Guiana. Some of these contain a percentage of sugar much higher than that of the sorts in general cultivation.

TEA.

Tea is not, strictly speaking, a tropical plant, as shown by the success of the experiments by the Department of Agriculture in the production of a high-grade article in South Carolina. Large quantities of tea are, however, produced in elevated regions inside the Tropics, notably in Ceylon and Formosa, so that there are probably no climatic obstacles to the growing of tea in any of the tropical possessions. Moreover, the tea shrub is a hardy plant, able to make growth in rocky or sandy soils which are worthless from the standpoint of many tropical cultures.

The curing processes, which largely determine the quality of the product, are receiving scientific study which may lead to the substitution of machinery for hand manipulation, which has formed so large a part of the expense of production.

TOBACCO.

Tobacco has long been a staple crop of considerable importance both in the Philippines and in Porto Rico. In the latter island a considerable expansion of the industry is now taking place, and the same may also be expected in the former, though the future of tobacco growing in the Tropics has been considerably unsettled of late by the discovery of methods of culture and curing which make it possible for temperate regions to produce tobacco of qualities equal to the highest grades of Cuba and Sumatra. It is accordingly quite possible that the center of gravity of this industry may change within a few years to the temperate regions of the United States, where agricultural skill and labor-saving machinery can so easily be brought into play without having to contend with the additional difficulties attendant on all branches of tropical agriculture.

VANILLA.

The so-called "vanilla beans" of commerce are the pod-like fruits of a climbing orchid, native in Mexico and Central America. The seeds are extremely small and dust-like, only the pod carrying the suggestion of beans. Moreover, the plant is never raised in culture from the seed, but from large cuttings.

Vanilla requires thoroughly tropical conditions and abundant moisture, except for two or three months of the year. Localities adapted to vanilla culture are probably to be found in Porto Rico and in the Philippines, perhaps also in Hawaii, but experiments must be intelligently undertaken, or they are sure to fail. In the first place, it is necessary outside the original home of the plant to pollinate the flowers by hand, and, in the second place, the proper curing of the fruits largely determines their market value, and, although the process is not a difficult one, it requires skill and experience. In other words, skilled labor is essential, whether obtained through special training or by importation from a vanilla-growing region. The bees which pollinate the vanilla in Mexico are known to be capable of domestication, though this knowledge seems not to have been utilized as yet.

VEGETABLES.

The growing of vegetables in Porto Rico for the winter markets of New York and other Eastern cities has naturally suggested itself as one of the potential resources of that island. That such an industry will not reach prosperity without encountering difficulties may be expected from the fact, already noted, that the prices of vegetables in Porto Rico equal or exceed those obtainable in our Northern cities. Bermuda onions, early potatoes, eggplants, tomatoes, and other vegetables can, of course, be sold in the United States at fancy prices in the fall and winter months, but to produce these and similar crops in commercial quantity and quality in Porto Rico will be the work of specialists in market gardening and not of the general public.

Another side of the vegetable question is of more general interest to the residents of tropical countries, and especially to planters dependent upon their own estates for supplying their tables with fresh food. The Tropics are not rich in food plants corresponding to the garden vegetables of temperate regions, and these seldom thrive as well in the Tropics as in the North, even when of tropical origin, owing apparently to the fact that our long hot summer days conduce to more vigorous and fruitful growth than the more equable and continuous humid climates of the moist Tropics, where the daily exposure to the sunlight is much shorter. In the Tropics, plants which make very quick growth, like radishes and lettuce, may reach edible size before the deterioration becomes apparent, while others are weak and spindling from the first, and never attain normal growth or maturity.

It is therefore not always wise to conclude, as the newcomer in the Tropics frequently does, that the inferiority of garden products is caused merely by bad methods of cultivation. On the contrary, it will usually be found that, in spite of apparent carelessness, the native has attended to some precautions unnecessary in the North but indispensable in the Tropics. The tropical planter should rely mostly on varieties

which have been tested locally, or at least in some part of the Tropics, since, in spite of their inferiority, these are often successful in comparison with the total failure of some of the best of temperate varieties. Furthermore, instead of vainly striving against the climate, he should become acquainted as rapidly as possible with the culture and uses of tropical food plants, the excellence of which is generally underestimated. Thus, cassava, yautia, and yams are the equals, and often the superiors, of the Irish potatoes and other temperate vegetables, to which Americans cling so tenaciously that they sometimes go hungry in the midst of unappreciated plenty.

THE PRESENT STATUS OF THE MEXICAN COTTON-BOLL WEEVIL IN THE UNITED STATES.

By W. D. Hunter,
Special Agent, Division of Entomology.

HISTORICAL.

THE INSECT IN MEXICO.

The history of the Mexican cotton-boll weevil (*Anthonomus grandis* Boh.) before its advent into Texas is most obscure. Aside from the fact that the species was described by Boheman in 1843 from specimens received from Vera Cruz, and that it was recorded in 1871 by Suffrian as occurring at Cardenas and San Cristobal, in Cuba, there is but little authentic evidence concerning its early history. It is known from written documents that the cultivation of cotton was practically abandoned in the vicinity of Monclova, in the State of Coahuila, in the year 1848, on account of the ravages of an insect. But that the insect was the boll weevil appears to be by no means certain. As far as the accounts indicate, it might have been the bollworm (*Heliothis armiger* Huebn.) or the cotton worm (*Aletia argillacea* Huebn.). But there is such a mass of testimony to the effect that the boll weevil has been known in that part of Mexico for many years, that it seems not unlikely that the date mentioned really indicates about the time when the insect first became an important factor in cotton raising.

By 1885, however, we find more definite and reliable data. In that year C. V. Riley published in the Report of the Commissioner of Agriculture a brief note to the effect that *Anthonomus grandis* had been reared in the Department from dwarfed cotton bolls sent from northern Mexico by Dr. Edward Palmer. This is the earliest account associating this particular species with the damage to cotton. The bolls referred to were collected in Coahuila and probably not far from Monclova. Long before 1892 the insect had invaded all parts of Mexico where cotton is produced, and about that year it was carried across the Rio Grande, perhaps in unginned cotton, and gained a foothold at Brownsville.

INVASION OF TEXAS BY THE INSECT.

Contrasted with the lack of data concerning the early history of the insect in Mexico, we find most complete accounts of its progress after the State of Texas was invaded. In 1894 the pest first came to the

notice of the Division of Entomology as an important enemy of cotton in Texas. An agent was immediately sent to the territory affected, which then comprised only a half dozen counties, and where the total output of cotton is not large. Professor Townsend's report was published in March, 1895. It dealt with the life history and habits of the insect, then absolutely unknown, the method of its importation, its capability for damage, and closed with recommendations for fighting it and preventing its further advance into the cotton-producing regions of Texas. It is much to be regretted that the State did not adopt the suggestion, made by the Division of Entomology at this time, of establishing a belt along the Rio Grande in which the cultivation of cotton should be prohibited, and thus cut off the advance of the insect. But a failure to realize the capabilities of the pest for destruction, as well as a disinclination to deprive the few farmers of that region of the only crop the climate permits them to raise, in a region moreover that invariably produces the first bale in the United States, were factors that combined to cause the authorities to delay until the opportunity had passed.

In 1895 the insect was found to have spread as far north as San Antonio and as far east as Wharton. Such an advance induced grave fears of future injury and caused the Division of Entomology to continue its investigations during the whole season. Mr. E. A. Schwarz, Mr. C. H. T. Townsend, and Dr. L. O. Howard were in the infested region. The results of the work were incorporated in a bulletin by Dr. Howard and published early in 1896 in both Spanish and English editions.

An unprecedented drought in the summer of 1896 prevented the maturity of the fall broods of the weevil, and consequently there was no extension of the territory affected. During this year the entomologists mentioned, with the addition of Mr. C. L. Marlatt, continued their observations and experiments, which resulted in another bulletin issued in February, 1897. This bulletin was published in Spanish and German editions for the benefit of the very large foreign population in southern Texas.

During 1897 the pest seemed to have not completely recovered from the unfavorable conditions of the preceding year, increasing its range only to the region about Yoakum and Gonzales. This extension, though small, was important, because the richest cotton lands in the country were beginning to be invaded. During more than half of this year Mr. Townsend was stationed in Mexico, in the region supposed to be the original home of the insect, to discover any parasites or diseases that might be affecting it, with the object in view of introducing them to prey upon the pest in Texas. Unfortunately, nothing was found that gave any hope of materially assisting in the warfare against the weevil.

In 1898 the season was very favorable for the insect, which increased its range into Bastrop, Lee, and Burleson counties, and even across the Brazos River into Waller and Brazos counties. The investigations of the Division of Entomology were continued, and a summary of the work dealing especially with the result of experiments with poisons, conducted by C. L. Marlatt, was published in still another bulletin.

SPECIAL INVESTIGATION AUTHORIZED BY CONGRESS.

At this juncture the legislature of Texas, in its 1898 session, realizing the danger that threatened the most important agricultural industry of the State, wisely made provision for the appointment of a State entomologist and a thorough investigation of the matter of combating the weevil. Upon this occurrence, and in view of the fact that at that time there was but little to indicate that the problem was any more than a local one, the Division of Entomology discontinued the work that had been carried on by having agents in the field almost constantly for four years, referring all correspondents to the State entomologist. But, unfortunately, the insect continued to spread in such a manner that other States than Texas were threatened. This caused the work to be taken up anew by the Division of Entomology in 1901, in accordance with a special provision by Congress for an investigation independent of that being carried on by the State of Texas, and with special reference to the discovery, if possible, of means of preventing the insect from spreading into adjoining States.

PRESENT SITUATION AND FUTURE PROSPECTS.

POSSIBILITIES OF CONTINUED NORTHWARD SPREAD OF THE INSECT.

By all means the most important aspect of the invasion of the weevil into the United States has been the possibility of its continued northward spread. In 1891, as may be seen from the preceding paragraphs, the insect was unknown in Texas. In 1895, as shown by the map (fig. 30), it had made its way 200 miles north of Brownsville, the point where it entered the State. At the present time it is found 500 miles north of that place, thus reaching a latitude within 100 miles of the latitude of the center of cotton production in the United States, according to the last census. The problem was serious enough when only a few counties in the most southern part of the State were concerned, because there a scanty precipitation makes cotton the only crop that can be cultivated to advantage. But as soon as the fertile and well-watered counties north of the Guadalupe were invaded the total Texas production was immediately affected, and grave fears were naturally aroused that the pest would reach all portions of the cotton-producing region of the country.

At the present time the territory affected is bounded roughly on

the north by a line drawn from Palestine to Waco, on the east by the valley of the Trinity River, and on the west by the limit of cotton cul-

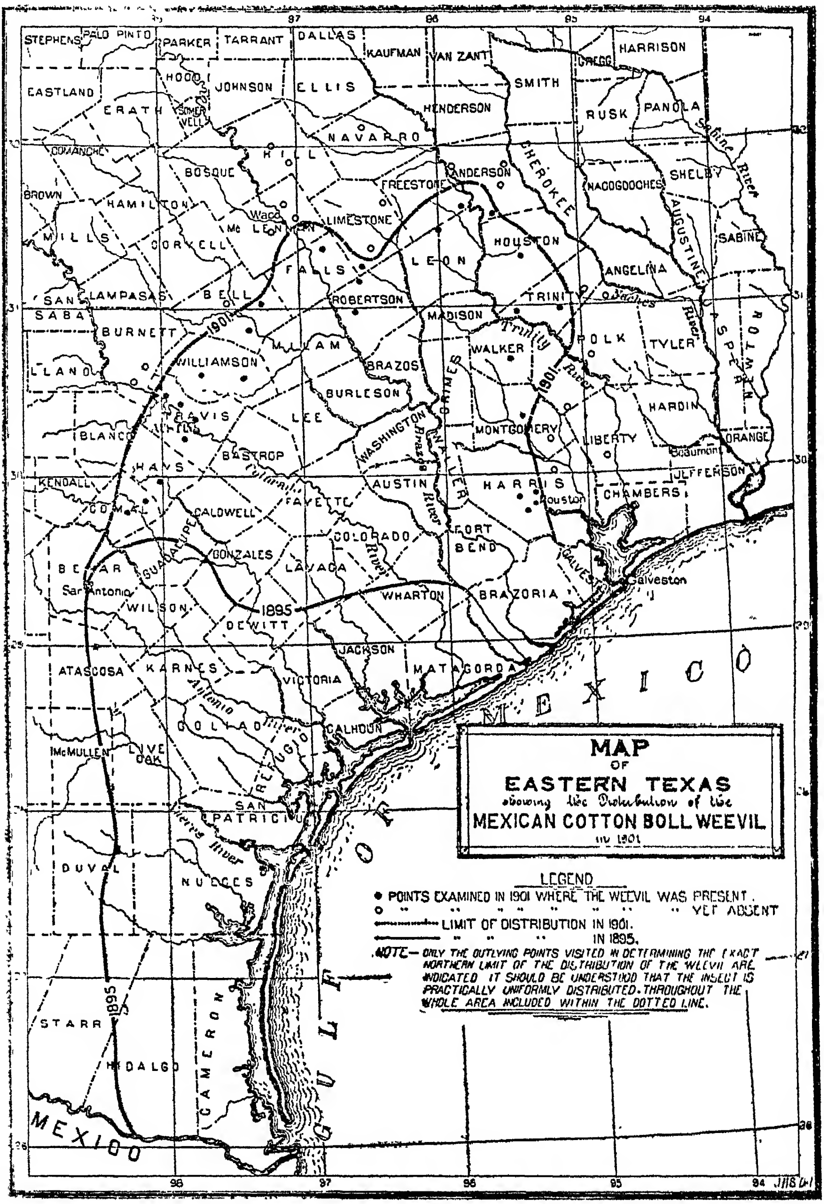

FIG. 30.—Distribution of the Mexican cotton-boll weevil in 1901.

ture. This includes fully one-half of the total cotton-producing area of Texas. The situation is more serious on account of the fact that the most productive counties are included in the infested territory. Of the

twenty-five counties that annually produce 25,000 bales or more, seventeen are now concerned. Statistics show that in these counties the devastation of the weevil has caused the amount of land required to produce a bale to be fully doubled. Where it formerly required on an average 2.3 acres to produce a bale of staple it now requires at least 4.5 acres.

NO INDICATIONS OF THE INSECT BEING KILLED OUT BY WINTER.

In all the area occupied at the present time the insect displays no signs of dying out, though there are instances easily accounted for where there has been a temporary diminution of its numbers. At one time it was supposed, since the weevil is of tropical origin, that it would reach a limit where the frosts of winter would annually check its advance, as is well known to be the case with the cotton worm (*Aletia argillacea* Huebn.). The winter of 1899–1900, however, bringing low temperatures that have never been equaled since records have been kept in Texas, demonstrated that such a hope is not to be relied upon. Temperatures like that of 14° F. at Austin, of 19° at Cuero, of 11° at Luling, and of 14° at San Marcos were found to have had no effect whatever upon the prevalence of the pests the succeeding season.

In this connection, it is important to notice the theory which is prevalent in some quarters, that the small number of weevils seen early in the spring indicates that the cold of winter kills the greater share of them. Many observations, however, made at Victoria and elsewhere make it evident that this phenomenon is as much due to the fact that the insects emerge gradually from their winter quarters as to any actual scarcity. As late as the 1st day of May, in southern Texas, weevils were still coming from the woods, and it required but little search to find them there. It is true that these observations were made in 1901 after an unusually mild winter; but the fact as related above, of the exceedingly cold winter preceding not lessening the insects, certainly bears out this supposition. Of course, many weevils do not survive the winter, but the dying of the debilitated individuals and the general vicissitudes of hibernation rather than cold alone seems to account for those that succumb.

INEFFECTIVENESS OF PARASITES AND DISEASES.

Though search has revealed several parasites and probably a fungoid disease of the weevil, it is not believed that these factors will ever be of much practical importance in reducing its numbers. Indeed, the habits of the insect are such as to largely preclude the possibility of effective aid from parasites. An insect occurring in such numbers as the weevil and being exposed in any stage, save the imago, to enemies, would certainly be greatly influenced by parasites; but this one, being well protected in egg, larval, and pupal stages by a dense covering of vegetable matter, remains remarkably exempt. The investigations of

the Division of Entomology in Mexico indicate that even where known to exist for half a century there are few and unimportant parasites to be found. Likewise, the history of other American, as well as European, species of Anthonomus bears out the supposition that but little of value will ever result from the work of parasites.

FUTURE SPREAD OF THE INSECT.

From what has just been stated it will be seen that two of the most important elements in limiting the spread of an insect, winter temperatures and parasites, in this case offer no assurance that the pest will soon be checked. It has been advancing year by year, and there are influences that seem to make it certain that the area infested will be constantly increased. The insect has extended its range eastward to within 100 miles of the Louisiana border. Though the intervening portion of Texas is not especially a cotton-producing one, several of the counties produce 5,000 bales annually, or much more than the counties toward Brownsville, in which there was enough cotton grown to make the original advance of the insect in the State quite rapid. It is certain that within the next two years Louisiana will be confronted by the same trouble that has been most seriously affecting the Texas producers. To the northward the movement will be more rapid. There is practically an uninterrupted cotton country before the insect, and its advance will be materially aided by the wind. The direction of the prevailing winds in Texas is northward, and there is an invariable equinoctial climax in their intensity in September, at the very time when the weevils are making their principal movements.

On the whole, it seems that, as the number of the pests in a certain region is practically only limited by the quantity of the food supply, so the weevil's progress will probably eventually be checked only by the limits of the distribution of cotton in the United States. This movement, however, the experience of nearly ten years indicates, will not be rapid, perhaps not much more than 60 miles per year. Moreover, it is likely that, before the pest has passed the boundaries of Texas, more will be known of controlling it, so that its damage in other regions will not compare with what was done in the parts first invaded.

TEMPORARY SCARCITY UNDER CERTAIN CONDITIONS.

The fact that in certain districts where the weevil has existed for several years an unexpectedly good crop has sometimes been raised has been the cause of a supposition among some planters that there is a tendency for it to die out or migrate to other parts. The most noticeable instance of this kind occurred in the counties of Wilson, Karnes, Goliad, Bee, and Live Oak during the season of 1900. It was in that region that the weevil first reached the portion of the State where

cotton is cultivated to a considerable extent, and there for several years, in the opinion of the planters, threatened to cause the entire abandonment of the industry. In 1900, however, the largest crop in the history of these counties was produced. A thorough investigation of this matter makes it clear that the explanation lies partially in the fact that several conditions reduced the number of the pests, and also as much in the fact that there were very exceptionally favorable conditions for the planting, growing, and early maturity of the crop.

For three years preceding 1900 there had been a scarcity of rains that caused not only very scant crops of cotton, but which destroyed a large percentage of the weevils which had been given opportunities for propagating. Continued dry weather is very disastrous to these insects. At Victoria it was found that during the drought in July, 1901, every larva in the square was killed in forty-eight hours, provided it was exposed in such a manner as to receive the unobstructed rays of the sun. Death resulted from the complete drying of the food supply. When the squares fell between the rows in such a way that they were shaded up to 10 o'clock in the morning and after 3 o'clock in the afternoon, under the same condition of drought, 75 per cent of the insects were killed in the same time. When it is remembered that the infested square lies upon the ground on an average ten days before the adult weevil emerges, the tremendous effect brought about by drought will be appreciated. Indeed, it appears that hot, dry, and windy weather is a far more important factor in destroying the weevils than either winter cold, excessive moisture, or any other climatic condition. There is no doubt that in 1896 an excessive drought not only prevented the weevil from spreading but actually caused the infested territory to become smaller. Accordingly, in explaining the bountiful crop raised in Bee County in 1900, the drought of the preceding seasons is most important. Moreover, in the region under consideration this drought had killed so much of the pasture grass that cotton fields into which to turn cattle to graze were at a high premium. Farmers in Bee County drove cattle 25 miles and paid high prices for the privilege of being allowed to pasture them in such fields. Consequently, practically all the larvæ in squares and bolls were devoured, and what survived were reduced by literal starvation. These remarkable conditions were followed in 1900 by a season in which every factor favored the growth of cotton. In Bee County the great drawback to cotton culture is the usual very meager rainfall, but that season brought more than 20 inches of precipitation above the normal. The rains, moreover, happily descended at such times as not to interfere with planting, thinning, or cultivating the crop. But in spite of all this, it must be noted that after these most favorable conditions the few weevils that had passed through the winter multiplied at such a rate that all the bolls formed after the middle of September

were destroyed by them. The following season there were apparently as many weevils as ever.

An instance of a similar scarcity, though due to quite different causes, has occurred during the present season (1901) in other counties in the valleys of the Colorado and Brazos rivers. Here the same unusual rainfall in Texas during the preceding season that made it possible to obtain a good yield west of the Guadalupe River, where a very scanty precipitation is the rule, gave the remainder of the southern portion of the State entirely too much moisture. The cotton fields, which are generally situated in the lowest portions of the valleys, were repeatedly swept by floods; for some days in the midst of the growing season these fields were under several feet of water. A more complete destruction of the crop by flooding could not have been accomplished. Moreover, in September of that year a hurricane of such intensity as to not only defoliate the plants that were left standing upon high ground but in many cases to actually uproot them, swept over this region. By these conditions not only were the weevils killed in great numbers, but the survivors found but little opportunity for propagating. The result was that the present season there were not enough weevils in the county to cause any appreciable damage.

In these two instances other influences, as, perhaps, the prevalence of parasites or diseases, may have had some effect upon the general condition, but those mentioned are certainly sufficient to account for the situation. It is needless to state that, with normal climatic conditions, the pests will in a year or two again become as numerous in Wharton County as they did in Bee County.

METHODS OF COMBATING THE INSECT.

The investigations of the Division of Entomology for nearly ten years have all pointed toward the primary importance of cultural methods of controlling this pest. All other methods must involve some direct financial outlay, either for materials or for machinery. In the present time of low prices for the staple and consequent small margin of profit any factor that increases the cost of production in the smallest measure will be very slowly adopted, and to be adopted at all must be of perfect working. To small, renting farmers, under the present conditions, a very few dollars per acre make the difference between profit and loss. On the other hand, cultural methods involving no cash, but only a small labor outlay, are more readily adopted, and seem altogether more in accord with Southern industrial conditions.

EARLY PLANTING.

Foremost among these methods is the simple expedient of early planting. All observations go to show that a small proportion of the pests pass through the winter, and that many of the individuals that

do survive are late in coming from their hibernating quarters. These breed in the fruit, soon becoming numerous enough to destroy every square as it is formed. Consequently, to hasten the maturity of the plant and thus cause the development of the bolls before the pests become abundant is a manifest advantage. The chief merit of this method is that it is in accord with the whole tendency of cotton culture, that is, to obtain an early crop. Early cotton produces the best staple, brings the best price, makes the return to the planter at a time when he needs it the most, and, moreover, avoids to a great extent damage to the plant by the boll-worm, cotton worm, and sharpshooter, as well as by a large number of fungous diseases. Northern seed produces plants that mature many days earlier than plants from local seed. Consequently, train loads of seed are annually brought from Arkansas and Indian Territory, and the competition for the first bale is as keen as ever. In fact, this bending of every factor to hasten the maturity of the crop has so taken possession of the system of cotton culture that any suggestion for fighting the weevil that runs counter to it is of very doubtful utility. The investigations of the Division of Entomology have demonstrated that it is possible to obtain a yield of the staple equal to the average production per acre in the United States—even in regions where the insects are very abundant, and where late cotton yields practically nothing—by this simple means.

Many practical illustrations of this fact are to be found in Texas. For instance, upon the plantation of Mr. F. H. Yunger, of Dewitt County, the present season (1901) there was a field, 15 acres in extent, planted early in March with seed from Arkansas of the quickly maturing King variety, that produced 5,475 pounds of lint, or about three-quarters of a bale, per acre, though the insects were so numerous by the middle of August that no top crop was made. Other cotton upon the same plantation and upon adjoining ones planted a month later, but similarly situated and otherwise treated in exactly the same manner, yielded only one bale to 8 to 10 acres. Great advantage seems to come from the use of seed of certain varieties that have been perfected to mature quickly, a matter that has received but little attention from the Texas planters.

DESTRUCTION OF THE PLANTS.

The observation, noted above, of the comparative scarcity of the pests in the winter and the facility with which many may be destroyed that would otherwise go into hibernating quarters to appear the following spring, form together the basis of the recommendation insisted upon by the Division of Entomology from the beginning—that the total destruction of the plants in the field should be undertaken as soon as the gathering of a top crop should become a doubtful matter. When the plants are allowed to remain in the field they simply form a means for

the insects to multiply long after there is any possibility of the cotton yielding any more fruit. In any case, the stalks have to be destroyed before planting again, and the advantage to come from fall destruction in the reduction of the number of the weevils abundantly warrants the general adoption of this measure. It appears that the maturing of a fall crop in many portions of Texas has always been more or less of a problematical matter. In Wharton County, for example, in twenty years, the planters agree, there has been a considerable top crop only in four or five seasons. Furthermore, accurate statistics for the past thirty years show an average yield per acre in Texas so low as to preclude the possibility of any important top crop. At any rate, it is now certain that where the weevil occurs there can be no dependence upon a top crop. Hence, destruction of the plants, say in October, or earlier if possible, in southern Texas should be generally enforced. This may be accomplished economically by cutting the stalks into pieces by means of a machine known as a stalk chopper, followed by burning, or the plants may be uprooted with a plow commonly used for that purpose in clearing cotton fields in the spring and then treated in the same manner.

Cattle will devour all green portions of the cotton plant, and though not, perhaps, a part of good farm practice, the turning of herds into the fields will accomplish practical destruction. This is practicable, however, only in fields that have been kept reasonably free from grasses and weeds which are preferred by live stock.

The obstacles in the way of general adoption of the destruction method are the custom of many renters to leave the land they have occupied during the crop year as soon as the cotton is picked, and the difficulty of obtaining concerted action. These obstacles, however, are not insurmountable, and it is to be hoped that a realization of the serious and permanent aspect of the situation will soon cause Texas planters to adopt the method universally.

It has repeatedly been observed that in the river valleys and in the immediate vicinity of timber the weevil causes its greatest damage, probably largely on account of more successful hibernations in such situations In many single fields a most marked difference in yield between the outermost portion and the portion near the timber has been observed. This leads to one of the most important recommendations that can be made, namely, that the lowlands should be reserved as much as possible for other crops, like corn, cane, and rice, to which they are better adapted, and which, moreover, are far more profitable than cotton. There seems no doubt that the State of Texas will be the gainer by leaving cotton out of the region where the weevil makes it an almost certain loss and devoting that land to other crops. The greatest agricultural need of Texas is a diversification of crops, and such a system will go far toward solving the weevil problem.

WIDE PLANTING AND HAND PICKING.

Besides the means mentioned, there are various measures that planters may resort to upon a small scale or under certain conditions that will afford some relief. Some importance should be attached to planting the rows as far apart as the nature of the soil will permit, as thereby the sun will be able to reach the fallen squares and kill many a larva that would otherwise mature. No general rule can be given in this matter, as there will naturally be the greatest variation between the rich alluvial river lands and the sandy portions of the high lands. But it is safe to state that the great majority of planters place the rows too close together for the proper growth and consequent yield of the plants; the experiment stations in nearly every State in the cotton belt have demonstrated it. In experimental plats on upland in Victoria County the present season (1901), where no means of fighting the weevil aside from wide planting were resorted to and where the planting was purposely made very late to test the matter, it was found that one-fourth more cotton was produced with rows at a distance of 5 feet than was produced upon the same land from the same seed with rows but 3 feet apart.

Where cotton is cultivated upon only a small scale and there is an abundance of labor, much good may be accomplished by hand picking of the weevils when they first appear and later of the drooping and fallen squares when the larvæ have begun their work. There is no doubt that in Victoria and other counties, where the most of the cotton is raised by small farmers, their energetic work in hand picking, induced by the offer of a bounty by the merchants, largely aided in causing a very fair crop to be made this season.

MACHINES.

The ingenuity of many persons has been taxed to invent machines that will assist in the warfare against the weevil. Aside from poisoning machines, these devices are of two types. One is designed to jar the insects and the affected squares from the plant and to collect them, while the other is intended to pick the fallen squares from the ground. In the cases of several modifications of the first type mentioned which were examined and tested, it was found that their workings were so faulty that to collect the insects by that means was a more expensive and troublesome operation than to do it by hand. It is very doubtful if machines of this kind will ever be of much practical importance. There is some hope that a machine that may pick by suction the fallen squares from the ground may eventually be perfected, but in such an event there are very few cotton fields so free from trash as not to make it almost impossible for such a machine to work. On the whole, it must be stated that there seems but little prospect for aid from machines designed for the destruction of the weevil.

CONCLUSION.

That the boll weevil is to be a permanent factor in cotton culture is a certainty, and that it is to spread outside of Texas is also inevitable. Local conditions may bring about temporary immunity in districts, but the general status will remain the same. Though much remains to be done in the matter of the investigation of means of fighting the pest, enough has been accomplished to show that it is not an insurmountable difficulty that confronts cotton planters. Without belittling the really serious nature of the problem, it must be stated that in many cases failure has been attributed to the weevil when it belongs to climatic conditions or to other circumstances, and attention is called to the fact that in many parts where the general loss has been very heavy, individual farmers by a few simple means have procured average crops. The seriousness of the case lies not only in the inherent difficulty of fighting an insect of the nature of the weevil, but quite as much in adapting methods of combating it to the peculiar industrial conditions of the regions concerned. A system of small, renting farmers, in most cases working only upon shares, with no cash in hand from one cotton picking to the next, with no guaranty on the part of the landowner of tenure for more than one year, or on the part of the renter of continued occupancy, presents by no means favorable conditions. But the people of Texas now realize the importance of fighting the weevil. This was shown the present season by the fact that various merchants' associations in about 25 towns expended an aggregate of nearly $5,000 in the payment of bounties for weevils and for squares in which they had deposited eggs. This beginning of cooperation between all concerned is the most hopeful assurance that these conditions will be righted, and that means for reducing the damage caused by the insect will eventually be generally adopted.

LITTLE-KNOWN FRUIT VARIETIES CONSIDERED WORTHY OF WIDER DISSEMINATION.

By William A. Taylor,
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INTRODUCTION.

In the introduction and dissemination of new fruits by commercial methods there is always danger that new varieties will be too largely planted in regions to which they are not adapted. Planters who learn of the remarkable success of a new sort in a remote section are inclined to plant it largely without sufficient investigation of its characteristics and requirements. This not infrequently brings upon them unnecessary financial loss.

With the present methods of illustrated advertising, the danger of inconsiderate planting is probably greater than in earlier days. Until comparatively recent times, the varieties of tree and vine fruits introduced from year to year were chiefly chance seedlings that had established their worth in the localities where they originated by a record of many years of production in comparison with the other sorts grown in the same localities. Records of a quarter of a century or more of fruitfulness are not infrequent in the histories of many of our standard varieties before they were accorded any special notice or propagated for dissemination in a commercial way. During these years of trial the changing seasons, with their extremes of heat and cold, rainfall and drought, brought to light such defects and weaknesses as existed in a variety, and the inferior sorts being weeded out in advance of general dissemination, future disappointment and loss were, no doubt, to a very considerable extent prevented.

Only a few of the thousands of the varieties that have been described and disseminated in America during the past century have survived and are now esteemed worthy of planting. At present, and with increasing frequency, varieties of many of the tree fruits are introduced within a few years after the first fruiting of the original trees, and necessarily, therefore, before the characteristic features are well known, even in the original locality. The risk of failure with such sorts is proportionately great, particularly in sections possessing different soil and climate, or where the market requirements are radically

different. The orchardist should, in general, therefore, be cautious in planting comparatively untried sorts. He should proceed in an experimental way, investigating as thoroughly as possible the requirements and characteristics of any sort unknown in his locality before planting it on a commercial scale. A few of the little-known fruit varieties, selected from a large number introduced in recent years, are described and illustrated in this paper with a view to furnishing detailed information to growers who desire to undertake a trial of sorts that have demonstrated their usefulness and value to an extent that warrants their wide dissemination and testing in climatic regions similar to those in which they have already been grown.

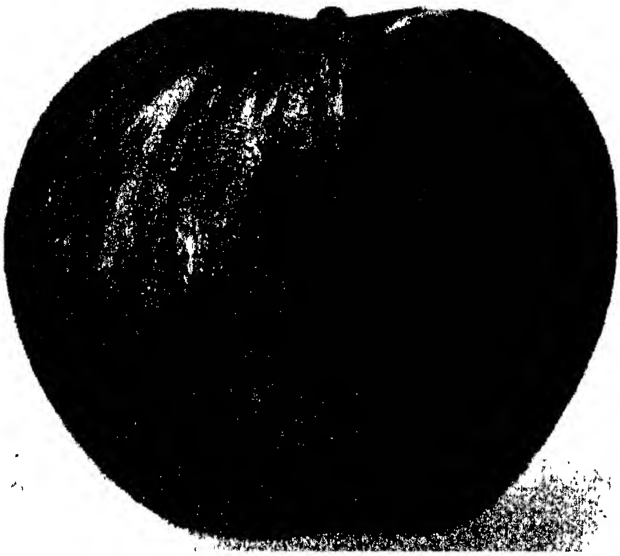
INGRAM APPLE.

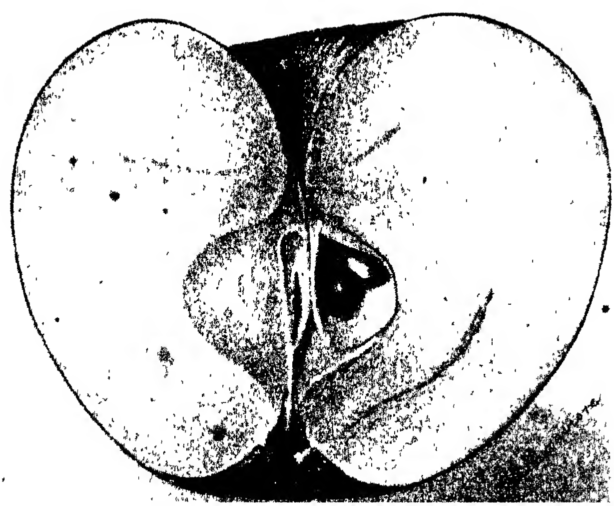
(SYNONYMS: *Ingram Seedling; Ingraham.*)

[PLATE XLVI.]

During the past five years this apple, which has long been grown in certain localities in Missouri, has attracted marked attention as a variety well adapted to planting in commercial orchards in that and neighboring States. Combining, as it does, the desirable characteristics of the old Ralls (variously known in the Middle and Southern States under the synonyms *Rawles Genet*, *Rawles Janet*, *Geniton*, *Neverfail*, and some twenty-five others), with larger size and brighter color than that well-known sort, it appears to have been first described and illustrated under the name *Ingram Seedling* in the Journal of Agriculture, published at St. Louis, Mo., and somewhat later, in 1868, in the Horticulturist, Vol. XXIII, p. 201.

According to various accounts, the variety originated from the planting of seeds of the "Ralls," by Mr. Martin Ingram, or his son Jack, 6 miles east of Springfield, Mo., about 1850 or 1855. Several trees were grown from the same lot of seed, and when they came into bearing the fruit was so hard that it was considered worthless. All were destroyed except one which had belonged to the boy Jack, who had then left home for the West. In the spring of 1862, when apples were scarce in the locality, several specimens were found under the tree in sound condition. They were not yet in eating condition, but when ripe, later in the spring, were of excellent flavor. The variety became locally known as "Little Jack," and was gradually planted throughout the neighborhood because of its productiveness and long-keeping qualities. Later it gained wide popularity, especially in Missouri and Arkansas, until it is now being largely planted in commercial orchards, especially in the former State, where one orchard as large as 240 acres is solidly set with it. The specimen shown in Pl. XLVI was furnished by Mr. L. A. Goodman, of Kansas City, Mo., secretary of the Missouri State Horticultural Society.





INGRAM APPLE.

DESCRIPTION.

Form roundish conical; size medium; surface smooth, pale yellow, washed with red, splashed and striped with crimson and overspread with gray toward the base, often covered with thin lilac bloom; dots gray, some with dark centers and often slightly indented toward apex; cavity regular, of medium size and depth and gradual slope, distinctly striped; stem rather short and stout; basin of medium size and slope and depth, slightly leather-cracked; calyx segments medium, reflexed at tip, eye closed or partially open, skin thick, tough, tenacious; core oval, of medium size, nearly closed, meeting the eye; seeds numerous, of medium size, angular, brown; flesh yellowish, fine grained, hard until fully ripe, then tender and juicy; flavor subacid; quality good to very good; season April to June in cellar storage in Missouri, but has been kept two years in this way.

The tree is an upright grower, hardy, blooming late, bearing regular, large crops. Its only defect appears to be its tendency to overbear, thus reducing the size of the fruit.

This variety is considered worthy of systematic testing throughout the South, especially in the mountain regions, where its parent, "Ralls," is one of the most reliable of the long-keeping apples, both for home use and for market.

M'INTOSH APPLE.

(SYNONYM: *McIntosh Red.*)

[PLATE XLVII.]

Among the winter apples of Northern origin that are as yet but little known to commercial growers, perhaps none shows a wider adaptability to diverse conditions or gives larger promise of success in the representative apple-growing regions than the McIntosh. Unlike many of the recently introduced varieties, it has not been widely advertised nor pushed by nurserymen, but it has steadily made its way through its intrinsic merit, and is now grown, to a limited extent, in many States. The original tree of this variety was discovered and saved, with several other seedlings of about 10 or 15 years old, by the late John McIntosh, in clearing away second-growth timber for a building place on his farm in Matilda Township, in the present village of Dundela, Ontario, Canada, about 1798. This original tree, though seriously injured by the burning of the homestead near it some years ago, is still standing, and is, therefore, more than a century old. The variety was not propagated in a nursery until 1837, when the son of the discoverer began its propagation in his nursery. It does not appear to have reached the United States until after 1870.

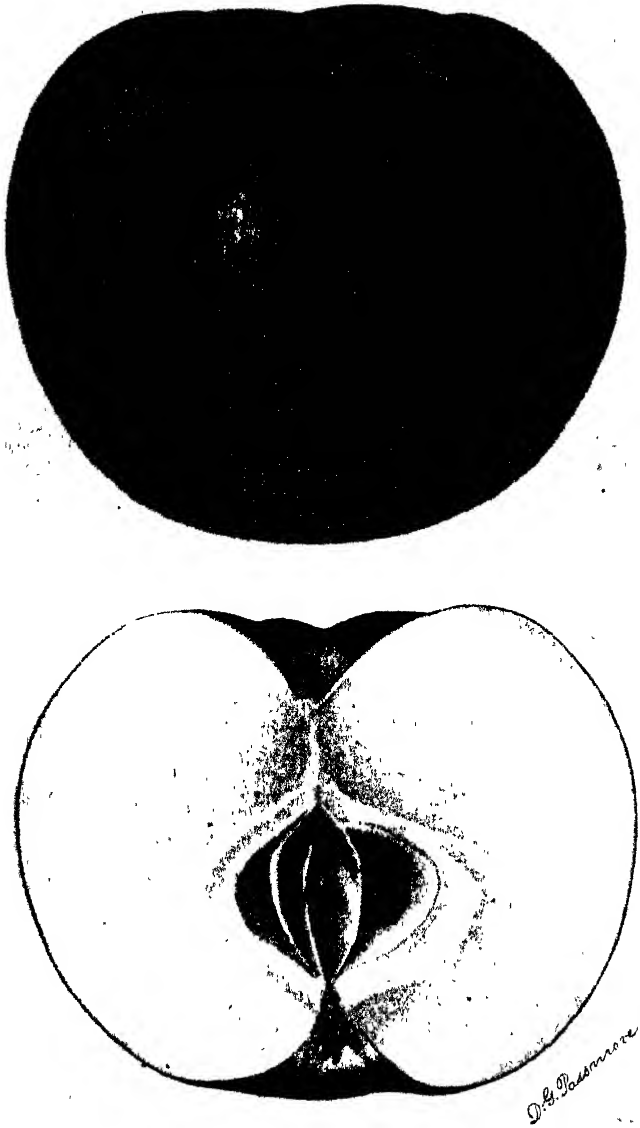
Charles Downing described it under the name "McIntosh Red," in the second appendix to the second revised edition of "Fruits and fruit trees of America," published in 1876, as "a good, annual bearer

of fair, handsome fruit of excellent quality, and valuable for home use and market." It is doubtful, however, whether he had fruited the variety himself at that time. Since that date it has gradually spread through the nurseries of Canada and the United States, frequently under the names of other varieties, until within the past five years its adaptability to general planting has become more generally recognized.

In addition to the vigor and hardiness of the tree, it combines the important requisites of good size, beautiful color, and fine quality of fruit. At the same time it is sufficiently productive to render it profitable to the commercial grower. It is somewhat susceptible to the attacks of the apple-scab fungus, but probably less so than any other widely tested variety of the Fameuse group. The fruit keeps until midwinter in the North in cellars, and, so far as tested, endures excellently in refrigerated storage. The specimen shown on Pl. XLVII was grown in the orchard of the New York State Agricultural Experiment Station at Geneva, N. Y., and is fairly representative of the variety as received at the Department of Agriculture from growers in a wide range of territory. Excellent specimens of it have reached the office of the Pomologist, in the ordinary course of correspondence, from Maine, New Hampshire, Vermont, Connecticut, Rhode Island, New York, Ohio, West Virginia, Wisconsin, Nebraska, and Montana, as well as from the Province of Ontario, in Canada. As a market sort, it is considered worthy of distinct recognition as a dessert apple, adapted to the requirements of the fancy fruit trade in the larger cities, ranking with Jonathan, Grimes, Esopus, and Northern Spy in this respect. As this trade requires fruit of fine quality, free from blemishes caused by diseases and insects, it is advised that planters of it be prepared to spray their trees thoroughly, and to pick, pack, and handle their fruit with special care in marketing. It appears to be especially adapted to marketing in boxes or other small packages in retail trade.

DESCRIPTION.

Form roundish, sometimes slightly oblate; size medium to large; surface smooth, sometimes slightly russet veined; color yellow, washed over most of the fruit with light crimson, frequently dashed with broken stripes of dark crimson and covered with a heavy bloom, which renders the ripening fruit very conspicuous on the tree; dots russeted, prominent, of variable size; cavity regular, deep, flaring, smooth; stem short to medium, downy, stout, fleshy at point of attachment to twig; basin regular, of medium size and depth, slightly furrowed; calyx segments medium, reflexed; eye small, closed; skin thin, tough, tenacious; core of medium size, roundish, clasping, open; seeds numerous, plump, brown, of medium size; flesh white, often slightly stained with light red, tender, juicy; flavor subacid, aromatic, highly esteemed



MC INTOSH APPLE.

CARMAN PEACH.

by those who like the Fameuse and similar varieties; quality good to very good; season December to February in cellar storage in the North.

Tree vigorous, with spreading head, hardy, long-lived, an annual bearer of good crops of fair and handsome fruit. The variety appears to be adapted to the conditions of the Northern States wherever Fameuse (synonym *Snow*) or Baldwin thrive, and to succeed much farther west and south than either of those sorts.

CARMAN PEACH.

(SYNONYM: *Pride of Texas.*)

[PLATE XLVIII.]

Since the introduction of Elberta (about 1880) demonstrated the commercial value of the Chinese Cling group of peaches in the South, there has been much activity among nurserymen and planters in the search for other varieties of this group ripening at different times, through which the shipping season might be extended. Numerous early sorts of this group have been disseminated during the past six or eight years, and are now under test in most of the commercial peach districts east of the Rocky Mountains. Among these, perhaps none is more promising from the standpoint of the commercial grower than t' e "Carman." This variety originated from planted seed by Mr. J. W. Stubenrauch, of Mexia, Tex., in 1889. The tree fruited first in 1892, and attracted attention both because of its earliness and its freedom from rot, a disease which is exceedingly troublesome on early varieties in that section. Mr. Stubenrauch at once began propagating it for his own planting, and at first named it *Pride of Texas*. Later he changed the name to "Carman," under which designation it was described in the Report of the Pomologist for 1894, p. 25. The description then published was based upon specimens grown by the originator.

DESCRIPTION.

A chance seedling, of the North Chinese type. Size large; broad oval, pointed, somewhat compressed; suture deep near cavity, shallow toward apex; apex fleshy, protruding; surface rather harsh; down short, persistent; color yellowish white, blushed and dotted with red; skin thin, not closely adherent; stone quite large, long, oval, pointed, free; flesh yellowish white, slightly tinged with red at the stone; flavor sprightly, vinous, slightly bitter; season middle of June, in Limestone County, Tex.

Tree reported to be productive, and fruit entirely free from rot; leaves large, with reniform glands; blossoms very large.

Since 1894 the variety has fruited in Texas, Georgia, North Carolina, West Virginia, Delaware, Connecticut, and Michigan, and has

demonstrated its usefulness and adaptability to conditions in all of these States. It ripens somewhat later than "Rivers," and will probably replace that sort in market orchards, as it is of firmer texture and much more resistant to rot.

RED JUNE PLUM.

(SYNONYMS: *Red Nagate*, of some; *Shiro Smomo*, of some; *Nagate no Botankyo*, *Hytankayo*, of some).

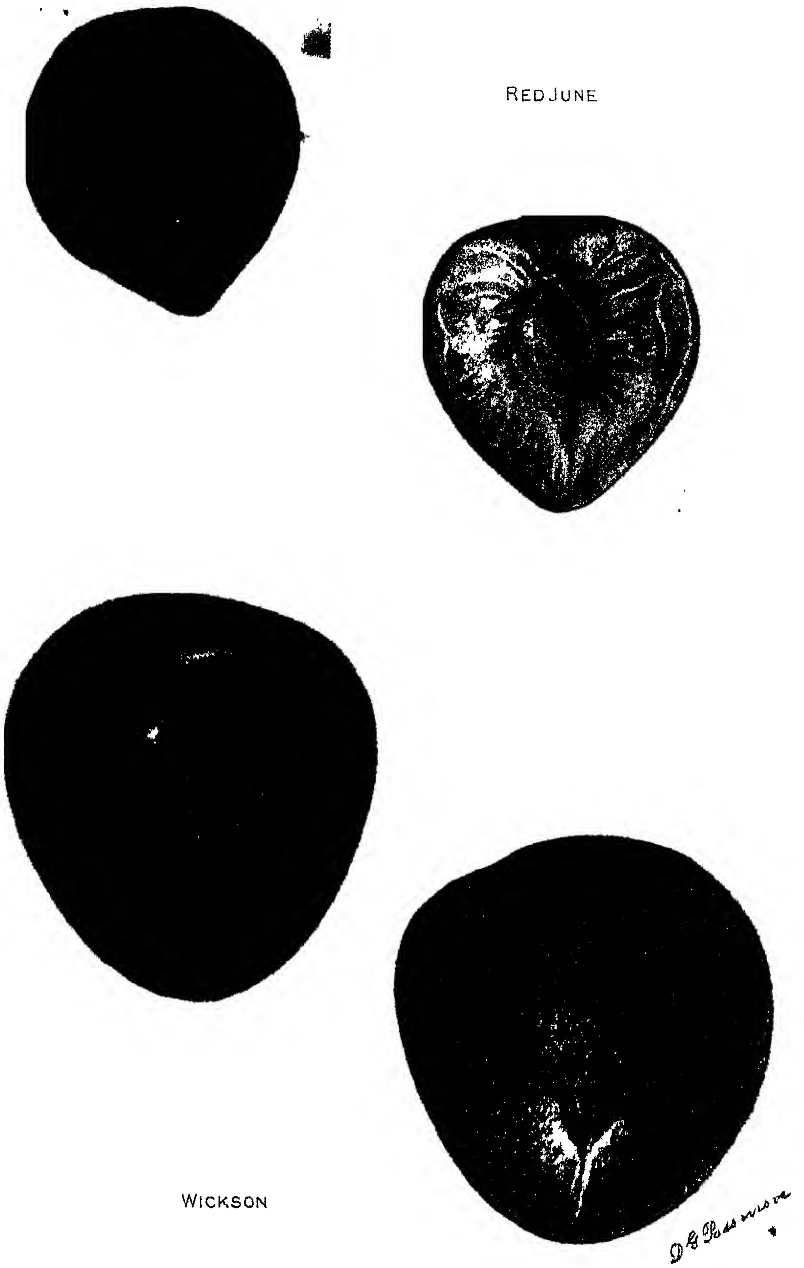
[PLATE XLIX.]

Among the more newly introduced Japanese plums that have been sufficiently tested to determine their commercial value in diverse locations, perhaps none has attained to the rank occupied by this early sort. According to Prof. L. H. Bailey, it was introduced from Japan by H. H. Berger & Co. This introduction appears to have been under the name "*Shiro Smomo*," and occurred about 1887. It was also received from Japan by Dr. J. T. Whitaker, of Tyler, Tex., at about the same time, under the name "Hytankayo." The variety does not appear to have attracted special attention until about 1892, when trees of it, obtained under the name "Shiro Smomo," were fruited by Stark Brothers, at Louisiana, Mo., who were strongly impressed with its value as a commercial sort. They at once propagated it extensively, and introduced it under the name "Red June" in 1893. It is a strongly marked variety, ripening in advance of Abundance, and enduring well the vicissitudes of commercial transportation. Though not of high dessert quality in the fresh state, it cooks well and forms an excellent substitute for the damson when canned or preserved. The specimen shown on Pl. XLIX was grown by Mr. George E. Murrell, at Fontella, Va.

DESCRIPTION.

Form roundish cordate, conical, often unequal, with a distinct point; size medium or slightly above medium; surface smooth, glossy, carmine, deepening to dark wine red when fully ripe, and covered with a bluish-white bloom; cavity regular, of medium size and slope; stem of medium length, rather stout; suture usually deep; apex prominent; skin thick, tenacious, slightly bitter; stone oval, pointed, of medium size, tightly adherent to flesh; flesh yellowish, translucent, with yellow veins; rather meaty, though tender and juicy; flavor subacid, pleasant; quality good.

The tree is an upright, spreading grower, vigorous and hardy, producing well in most plum-growing sections, though blooming very early in middle and southern latitudes, and, therefore, somewhat subject to frost injury in spring. It is probably benefited by cross pollination, and should be planted with such varieties as Burbank, Abundance, Chabot, or Satsuma, which Professor Waugh, of the Vermont



WICKSON AND RED JUNE PLUMS.

Agricultural Experiment Station, has found to cover most of its blooming period. The variety is hardy in fruit bud when dormant, enduring low winter temperatures, and appears to be promising for the commercial planter in all sections where earliness and resistance to rot are important.

WICKSON PLUM.

(SYNONYM: *Perfection.*)

[PLATE XLIX.]

This variety, one of the first valuable sorts of the Japanese type originated in this country, was grown by Mr. Luther Burbank, of Santa Rosa, Cal., from a seed of Kelsey. The first specimens of this variety received at the Department of Agriculture were furnished by Mr. Burbank under the provisional name "*Perfection*," in August, 1892, with the statement that the original tree was grown from "Kelsey seed crossed with Burbank pollen." The variety was briefly described under that name in the report of the Pomologist for that year, p. 263. It was commercially introduced by Mr. Burbank in 1893 under the name "Wickson," and was widely distributed in 1894 in the form of grafting wood. Scions top-worked on bearing trees in Michigan fruited largely in 1896, and their fruit surpassed in size and beauty the specimens previously received from the originator. Young trees planted at various points from Georgia to Connecticut and throughout the West have thus far borne rather sparingly, and the fruit has been found quite susceptible to rot in wet seasons. Notwithstanding these defects, the variety is one of much promise and worthy of planting in an experimental way wherever plums are grown. The specimen shown on Pl. XLIX was grown by Mr. George E. Murrell, at Fontella, Va.

DESCRIPTION.

Form oblong conical, sometimes distinctly pointed; size large to very large; surface smooth, glossy, with numerous minute russet dots; color yellow, washed and marbled with dark brownish red, giving it a very rich, variegated effect; bloom thin, transient; cavity rather large, deep, and abrupt; stem rather stout; suture deep at base and distinct to apex; skin moderately thick, tenacious, rather acid; stone oval, of medium size, semiadherent; flesh yellowish, translucent, with yellow veins, firm and meaty when ready for market, but melting and juicy when fully ripe; flavor sweet, rich, aromatic; quality very good.

The tree is very erect, with long and narrow leaves, and the fruit is borne on spurs on the old wood rather than on the strong leading shoots of the previous year, as with most of the Japanese sorts. It is hardy and blooms abundantly, but its productiveness in the Eastern States is yet to be established. It is one of the earliest to blossom, and should probably have such early sorts as Red June, Burbank,

Abundance, and Chabot planted with it for cross pollination. The erect habit of the tree and the peculiar character of foliage have been considered by Bailey and Waugh as evidence that the Simon plum (*Prunus simonii*) entered into its parentage, and there is much to support this view. The writer sees no reason to doubt that Kelsey was the seed parent, however, as stated by the originator, both in correspondence and in his original description of the variety.

This tree has been largely planted in certain localities in California, and the fruit of it grown in that State has been found to bring very high prices on the Eastern markets in the fresh state.

DOWNING GRAPE.

(SYNONYMS: *Charles Downing; Ricketts No. 1.*)

[PLATE L.]

Most of the native grapes thus far developed have been found deficient in keeping quality. In this respect they are distinctly inferior to many varieties of *Vitis vinifera* grown in the Old World and upon the Pacific coast. One of the most notable exceptions is the Downing, which originated with Mr. James H. Ricketts at Newburgh, N. Y., about 1870, as a hybrid of Israella and Muscat Hamburg. It first attracted public notice in 1873, when it was exhibited at the Boston meeting of the American Pomological Society, and again in 1875, when it was examined with other seedlings on the grounds of the originator by a committee of the American Pomological Society, composed of J. J. Thomas, Charles Downing, and Patrick Barry, and favorably reported on[1] under the designation "*Ricketts No. 1.*" It was subsequently named "*Charles Downing*" by Mr. Ricketts in honor of his neighbor, the distinguished pomologist. It was introduced by Mr. J. G. Burrow, of Newburgh, N. Y., in 1883, and considerably disseminated among amateurs. It has not attained prominence as a market sort. The cluster described and illustrated on Pl. L was grown by Mr. C. C. Corbey, at Montclair, N. J.

DESCRIPTION.

Cluster large to very large, moderately loose, sometimes shouldered; berry medium to large, roundish oval; skin rather thick; color brownish black with a thin, light bloom; flesh tender, breaking, juicy; seeds of medium size, two or three to the berry; flavor mild, sweet and sprightly; quality very good; season late; an excellent keeper and shipper.

The vine is a vigorous grower with healthy foliage. It is somewhat subject to mildew in unfavorable seasons, and should be thoroughly sprayed whenever that disease is prevalent.

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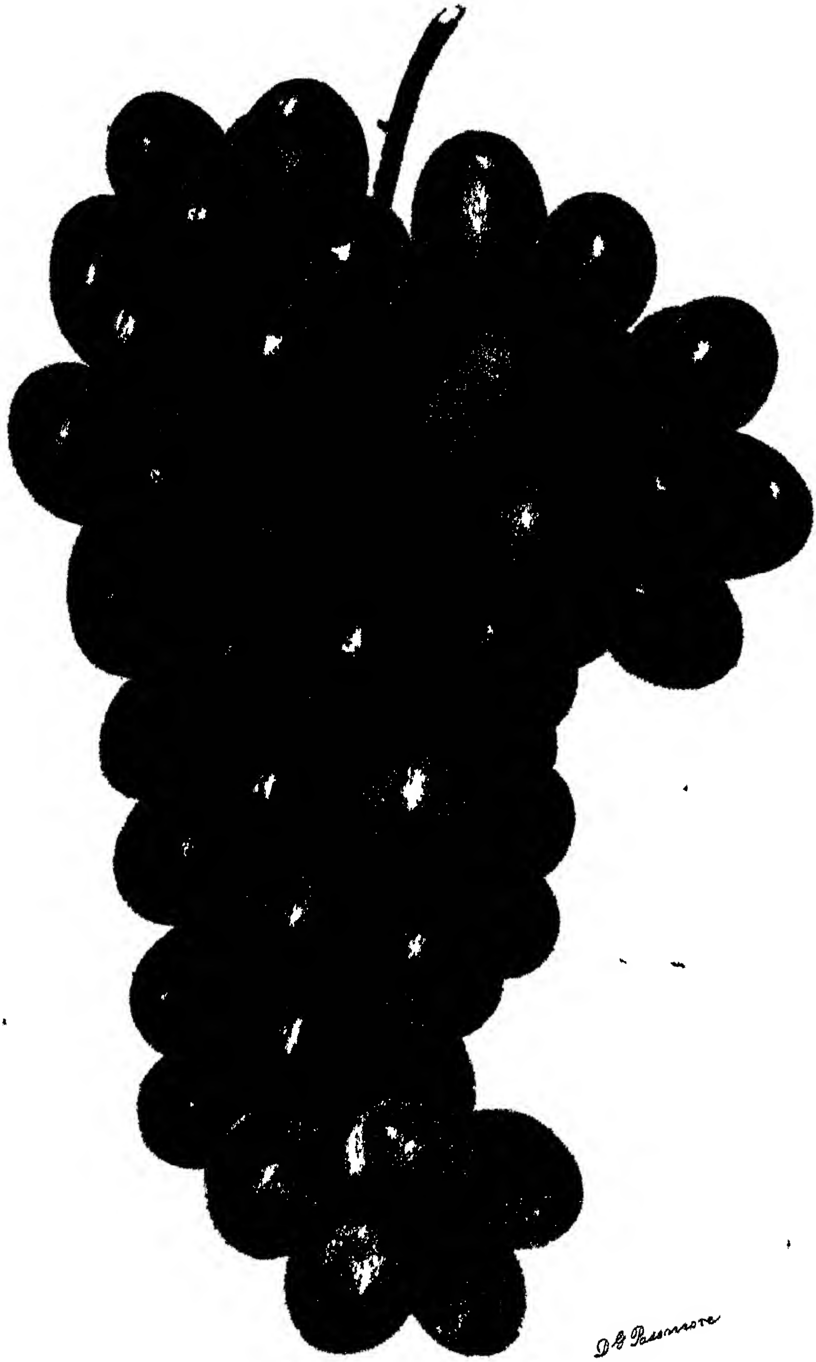
[1] Proc. Am. Pom. Soc., 1875, pp. 112-114.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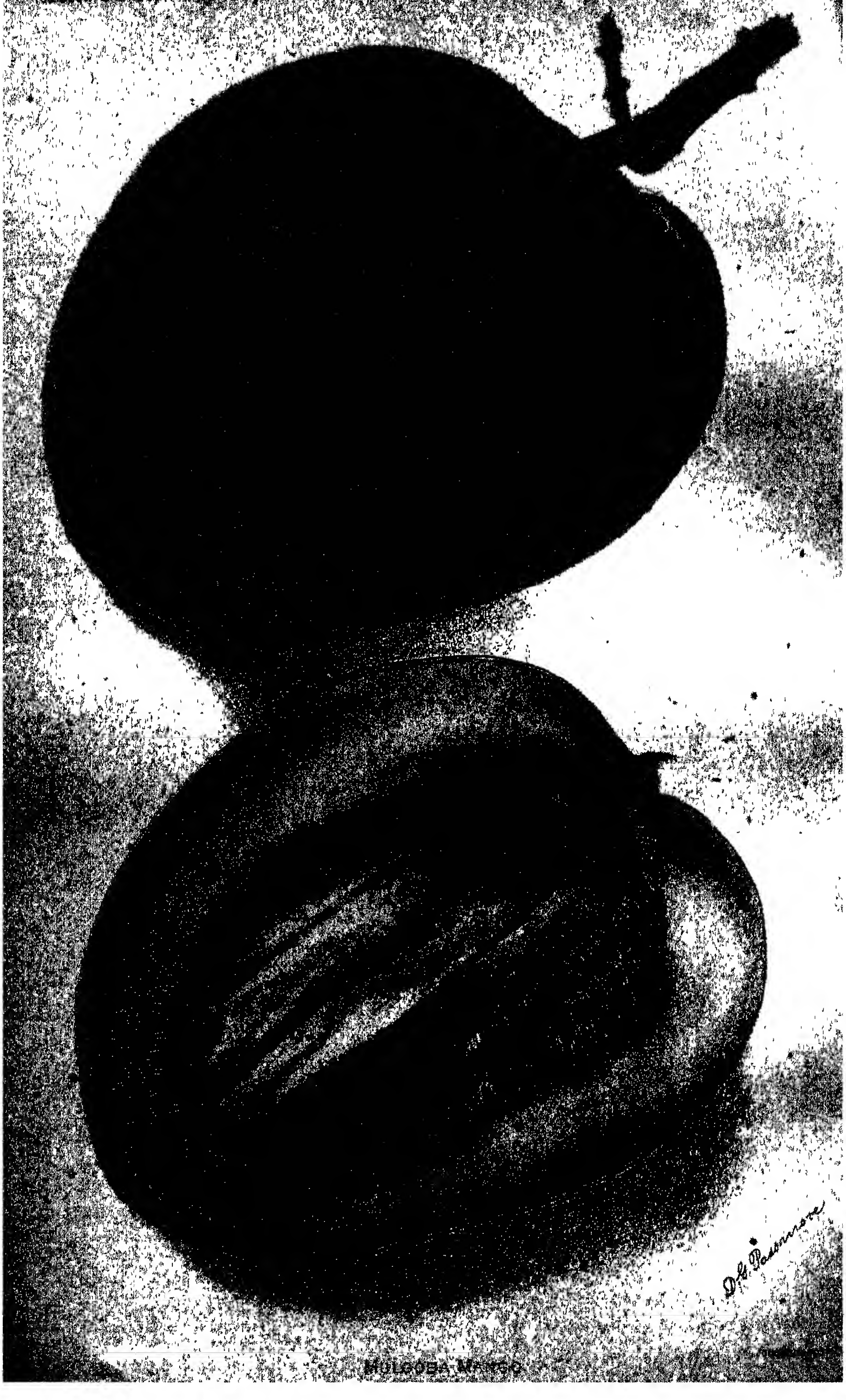


MULGOBA MANGO.

Though sufficiently hardy for the important grape districts of the East, it will probably be advisable to take down the vines from the trellis to afford partial protection in severe winters. Like other grapes of fine quality, the vine should not be permitted to overbear when best results are desired. As a grape for amateurs it is commended as one of rare beauty and superior excellence; also as one of the most promising sorts for the grower who supplies a special trade that demands and is willing to pay for fruit of fine quality.

MULGOBA MANGO.

[PLATE LI.]

The mango is, comparatively speaking, one of the more recent introductions from the Old World. It is native in India and elsewhere in southern Asia. It did not reach Europe until 1690, when it was introduced to cultivation in hot houses in England. It is reported to have reached the West Indies from Brazil about the middle of the eighteenth century, and Jamaica in 1782, where it soon became naturalized. It appears to have reached Florida first at Indian Key, where it was introduced by Dr. Perrine in 1840, but these plants failed to survive the neglect that followed the murder of that enterprising horticultural pioneer by the Indians in May of the same year.

It was again introduced, probably from Jamaica, about 1870, at Point Pinellas, and a third time, in 1877, in the same locality, by Mr. William P. Neeld. The rapid growth, precocity, and productiveness of the trees grown by Mr. Neeld, together with the high prices obtained for the fresh fruit, both for home use and shipment, resulted in large plantings throughout central Florida.

Single trees but 6 years old from the seed are reported to have yielded upward of $50 worth of fruit in a season, and in one instance two seedling trees 8 years old bore a crop estimated at 19,000 fruits. The freeze of January, 1886, checked the rapid expansion of mango plantations, however, as it killed to the ground practically all the mango trees north of the Caloosahatchie River. Sprouts from the old trees and young seedlings rapidly came into bearing, so that there was a considerable annual production of fruit from about 1890 to 1894, inclusive. The disastrous freezes of December, 1894, and February, 1895, proved fatal to most mango trees north of the Caloosahatchie River and Lake Worth, however, and since then production and planting have been chiefly limited to the region below these points.

During the earlier years of cultivation in Florida little effort was made to perpetuate choice varieties, except through seedlings. The species is propagated with difficulty by budding and grafting, and not until recently have the details been mastered sufficiently to render commercial propagation possible. In India, where the species has been grown under cultivation for centuries, inarching is practiced, but

the trees propagated in this way appear to be generally weak and short lived because of the imperfect union of stock and scion that commonly results. In Jamaica and elsewhere in the West Indies little progress has been made in propagating by any other method than the growing of seedlings, though a few trees of several choice varieties have been successfully inarched.

Prior to 1889 none but seedling mango trees were grown in Florida. In that year an importation of eleven grafted or inarched trees of five varieties was received from Bombay, India, by the Division of Pomology, and placed with fruit growers on Lake Worth, in Florida, for testing. The trees were in poor condition on arrival, and through gradual deterioration and the effects of the freeze of February, 1895, all save one perished before maturing fruit. The surviving tree, a Mulgoba, quickly recovered from the effects of the freeze, and has borne regular annual crops of fruit of very superior quality since 1898. Its introduction marks the beginning of systematic, rational mango culture in the United States. Recent experience indicates that the mango can be successfully grafted in Florida, and the variety is now quite generally distributed along the lower east coast, where it appears to thrive. The specimen illustrated was from the original imported tree now standing on the grounds of Prof. E. Gale, at Mangonia, Fla.

The success of Mulgoba since it has become established in Florida, and the marked improvement in the methods of propagating this fruit by budding and grafting, should encourage judicious effort to introduce other choice varieties of the mango that have long been known to exist in India. Several of these are considered of greater value than Mulgoba, some because of their greater productiveness, others because of their superior quality, and still others because of their earlier or later ripening.

While the efforts to grow this fruit in California have hitherto not resulted in the production of fruit of choice quality, it seems not improbable that through the introduction of early ripening varieties, mango culture may yet be successfully established in the frostless thermal belts of the southern portion of that State.

DESCRIPTION.

Form roundish, oblique, reniform; size large, weighing from three-fourths pound to 1 pound; surface smooth and undulating; color yellow, beautifully blushed with red and faintly dotted with numerous brown dots; skin thin, tough, tenacious; seed reniform, oval, rather large; fiber scanty, fine, and tender; flesh rich, apricot yellow, very tender, melting and juicy, sweet, rich, fragrant; quality very good.

The Mulgoba surpasses in flavor and quality the seedlings previously grown, but its most distinctly marked features of superiority are the

tenderness of flesh and absence of the objectionable fiber and strong turpentine flavor common to most of the seedlings grown in this country.

The tree is a strong, symmetrical grower, and appears to be abundantly productive. It is considered worthy of experimental planting in eastern Florida, south of latitude 27°, and on the Keys, as well as in the frostless belts of southern California and in the new tropical island possessions.

ADVANCE LOQUAT.

[PLATE LII.]

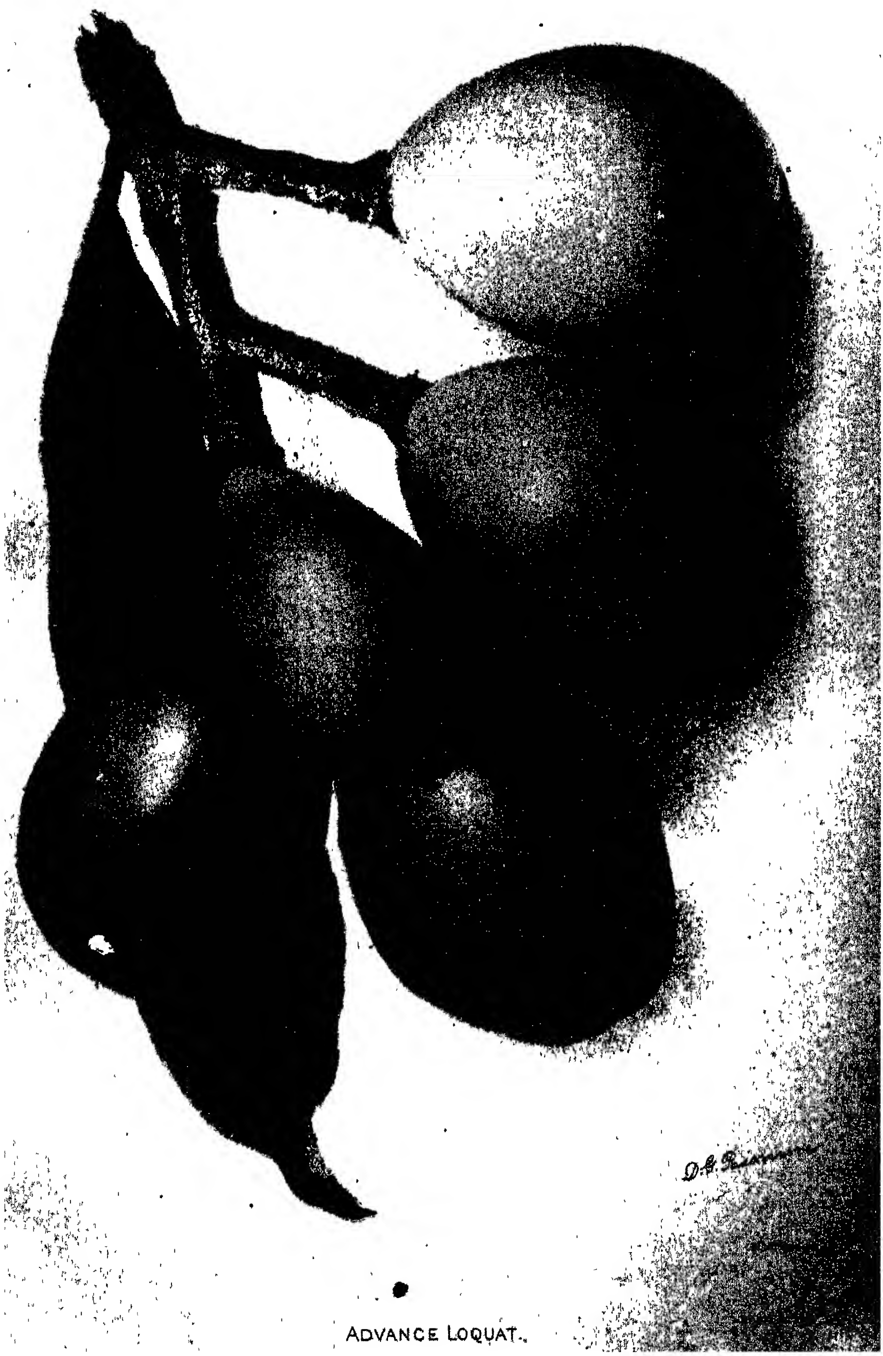
The loquat (*Eriobotrya japonica*, formerly known as *Photinia japonica*) is a Japanese evergreen tree that promises to attain commercial importance in the milder portions of the United States. It was introduced into England in 1787, and soon thereafter became a popular garden fruit in the Mediterranean region. The exact date of its introduction into the United States is not recorded, but it has long been grown in the Gulf States, frequently under the erroneous names "*Japan Plum*" and "*Japan Medlar*." More recently it was introduced into California. The species is sufficiently hardy to endure ordinary winters on the Atlantic slope as far north as Washington, though it succumbs to the lower temperatures that usually occur at intervals of a few years, except in specially favored localities. The fact that it blossoms late in autumn and does not ripen its fruit until about April or May will probably prevent it from attaining economic importance north of the Gulf States. In the form of seedling trees it has been grown in considerable areas near the larger towns in Florida and near New Orleans, La., for many years, the delicate texture of the ripe fruit having restricted it almost entirely to near-by markets until recently. With the improved methods of transportation now in use, however, there appears to be no reason why the fruit should not be safely transported across the continent and placed before the consumer in good condition.

The seedlings of the loquat show wide variation in size, form, and flavor of fruit, as well as in the relative proportion of seed to flesh, and rapid improvement by selection has long been recognized as possible. Until recently, however, there appears to have been but little systematic work along this line. In fact, there appears to have been little effort to perpetuate choice seedlings by grafting in this country until about 1888, when a variety known as "Giant" was introduced from Japan by H. H. Berger & Co., of San Francisco, Cal., in the form of grafted trees. The species belongs to the Rose family, and unites more or less freely with pear, quince, and hawthorn stocks, though in this country loquat seedlings are most commonly used to bud and graft

upon. In California budding is more commonly practiced, using seedling loquats about 9 months old, and approximately 1 inch in diameter. Buds are tied in with paraffin cloth. The stocks are cut back about three weeks after budding, leaving three or four leaves, until the bud has made from 4 to 6 inches of growth, when it should be cut close to the inserted bud and waxed over.

Perhaps the most successful originator of varieties of the loquat in this country thus far is Mr. C. P. Taft, of Orange, Cal., whose seedlings have attracted wide attention. One of the best of these, the "Advance," is illustrated on Pl. LII, from specimens grown by Mr. Taft. It is a very large loquat, about three times the size of the ordinary seedling, and double the size of the "Giant." The fruit is borne in very large terminal clusters, and is of refreshing, subacid flavor, with less than the usual proportion of seed to flesh. It endures shipment well, having been successfully forwarded from southern California to Chicago, New York, and Washington. It is commended for experimental planting in the Gulf States and the warmer valleys of California.

In recent years there has been much interest in the Mediterranean region in the improvement of this fruit. Experimenters in Italy and Algeria have produced seedlings said to vary very greatly in size, quality, and proportion of seed to flesh. As a number of their best varieties have recently been secured through the Section of Seed and Plant Introduction, a considerable increase in the commercial planting of this wholesome fruit may reasonably be expected in the near future.



ADVANCE LOQUAT.

DIETARIES IN PUBLIC INSTITUTIONS.

By W. O. Atwater, Ph. D.,
Special Agent, in Charge of Nutrition Investigations, Office of Experiment Stations.

Introduction.

There are in the United States a very large number of persons maintained partly or wholly at the public expense and in institutions under public control.

Broadly speaking, the institutions under such control may be grouped as follows: (1) The Army and Navy; (2) schools, colleges, universities, and other educational institutions; (3) hospitals, sanitariums, and insane asylums; (4) orphanages and homes for children; (5) almshouses and similar charitable institutions; and, (6) houses of correction, prisons, and other reformatory and penal institutions.

Comparable with the above in respect to the nourishment of large groups of persons may be mentioned ocean steamers and other vessels, hotels and boarding houses, camps and expeditions, and in general all cases where there is necessity for providing food for a large number of persons for a longer or a shorter time.

REVIEW OF DIETARY STUDIES.

The problem of properly feeding the Army and Navy has for many years received the attention it deserves, and in general it may be said that all civilized nations make the attempt to do this in accordance with well-established principles of nutrition. The United States is not behind other nations in this respect, and the use which has been made in this connection of the results of American nutrition investigations was one of the earliest proofs of their practical utility.

Many dietary studies have been made at schools, universities, and other educational institutions, but as yet the material is hardly sufficient in amount for general deductions, as the conditions in the different studies have been far from uniform. However, enough has been accomplished to show the importance of the work, and in individual instances it has been possible to make suggestions for improving the diet materially without increasing its cost, or for decreasing the cost without affecting the nutritive value or attractiveness.

The subject of hospital dietaries and the proper feeding of those who are ill or convalescent has been studied perhaps more than any branch of the general subject of dietetics. The work has been largely and quite naturally carried on in connection with other investigations

pertaining to the practice of medicine. It is, however, so closely connected with the nutrition of normal men in health that no sharp lines can be drawn between the two kinds of investigation. So much has been accomplished that most well-managed hospitals make the attempt to provide different diets suited to general classes of patients, as well as diets for special cases. The information now accessible regarding the food requirements in certain diseases and the salutary effects of proper food is surprisingly large compared with what was known only a few years ago, although much information is still needed in this as in other lines of research.

So far as can be learned, comparatively few investigations had been made in this country regarding the food requirements of the insane until the matter was taken up by the writer at the request of the commission in lunacy of the State of New York. This work will be referred to later.

A number of investigations have been made in this and in foreign countries with a view to determining the best and most economical diet for inmates of charitable institutions. It is generally agreed that food furnished the inmates of such institutions should be palatable, wholesome, and reasonably attractive, while it is usually necessary to keep the cost moderate. It has been frequently shown that a marked improvement in quality, quantity, or both, was possible without additional cost; and other important improvements demanded by special cases have been suggested.

The subject of dietetics in relation to reformatory and penal institutions has received a great deal of attention at the hands of prison authorities, State officers, and scientific investigators. Much remains, however, for the student to do along these lines, as it is evident that the food requirements of healthy individuals under more or less close confinement may be different from those of individuals under normal conditions. While perhaps none would consider it desirable to supply the inmates of such institutions with an over-attractive diet, yet it has come to be quite generally recognized that poor and insufficient diet is a rather questionable punitive measure, and that humane treatment demands wholesome food, sufficient in amount to meet the physiological demands of the body.

Roughly speaking, one-third of the persons fed in hospitals, penal and benevolent institutions, and the like in the United States are inmates of prisons, jails and reformatories, and kindred establishments; one-fourth are inmates of almshouses; one-fourth are found in hospitals for the insane, and the remainder are in hospitals and other benevolent institutions. The major portion of the inmates of the benevolent institutions, however, are not supported at public expense, and there are likewise many insane not found in the public institutions.[1]

[1] See report U. S. Census, 1890.

RESULTS OF SCIENTIFIC RESEARCH APPLIED TO PRACTICAL USE.

As above stated, the subject of dietetics in relation to the Army and Navy has received considerable attention. The same may be said of dietetics in relation to hospitals and similar institutions. In all such cases it is a comparatively easy matter to show how much practical benefit has been derived from abstract investigation along the lines of physiological chemistry as applied to food and nutrition; but, so far as the writer is aware, no extended compilation has been made of the results of inquiries regarding prison dietaries, nor, indeed, of the storeroom, kitchen, and dining-room management of public institutions generally. The collating of such results obtained from scientific inquiry and from intelligent practical experience, both in this country and in Europe, would be a most useful work.

In the present article the attempt is made to summarize some of the recent work in institutions under public control, confining attention chiefly to prisons and hospitals for the insane, and citing especially the results obtained by the writer in a recent investigation of the dietary conditions in the hospitals for the insane in New York. The special object is to show that such investigations are of great practical benefit, and may be extended to all institutions under public control, or, in general, to all cases where large numbers of people are to be fed both economically and well for a longer or shorter time.

The writer is informed by one of the officers in charge of charitable institutions in the State of New York that not far from 100,000 people are housed, clothed, and fed in public institutions in that State, and that the care of these people costs the State about $26,000,000 per year. Of this amount, the expenditure for food varies from 20 to 29 per cent in the different institutions, including poorhouses, hospitals, prisons, and the like. Taking the average at 23 per cent, the cost of the food would be about $6,000,000 annually. Of the number of people of the dependent and delinquent classes who are maintained at public expense in the United States as a whole, the annual cost of their maintenance and the share expended for food, no exact data are available, but the figures must be very large.

It is natural to ask, Are the people in public institutions throughout the country being fed in the best ways, that is, in the most advantageous and economical ways?

This much is certain: The kinds of food, the methods of storing, cooking, and serving at the table, the attractiveness, and the cost are extremely variable in different institutions for people of the same class. A costly diet is often unsatisfactory; the more economical one is often highly acceptable. Managers and friends of public institutions are in many cases persuaded that important dietetic improvements are both called for and feasible. In a number of instances improvements have been made with great advantage to the employees,

inmates, and expense accounts of the institutions. Public interest in these subjects is increasing. The time is ripe for a more general and a more careful study of the subject and for more widespread and effective application of the results.

In the home, on the farm, in the factory, in commercial establishments, on railroads, in municipal enterprises, indeed, almost everywhere, the results of scientific research are being put to practical use. It would seem that they ought to be capable of being utilized more than they now are in the dietetic management of public and private institutions. Indeed, a great deal has already been done in this line, more especially in Europe, where much important information has been accumulated concerning food and nutrition in general and dietetics of institutions in particular. The most thorough scientific investigations in this general field thus far are those made in Germany, though much has been done in other European countries, and most excellent work has been done in Japan. In England there has been a pronounced movement toward the establishment of revised and improved standard dietaries in prisons and workhouses, based upon the dietetic needs of the persons nourished.

EXPERIMENTAL INQUIRY REGARDING FOOD AND NUTRITION OF MAN.

Of late, and especially during the past ten years, there has been a large amount of experimental inquiry in this country regarding the food and nutrition of man. A large part of this inquiry has been conducted, under authority of Congress, by the Department of Agriculture in cooperation with universities, colleges, technical schools, experiment stations, charitable organizations, and social settlements in different parts of the United States, literally from Maine to California and from Minnesota to Alabama, though extensive and important contributions have come from other sources. As a result, we have to-day over 4,000 analyses of American food materials, so that the chemical composition of nearly all the more common foods is pretty well known. There have been made also some 350 studies of the actual food consumption of families or groups of persons in boarding houses and institutions, comprising in all some 1,800 persons in families and boarding houses and 30,000 in insane hospitals and penal institutions, thus throwing light upon the actual dietary habits of a large number of persons under widely different conditions of environment and occupation. The results of some 300 digestion experiments, mainly with men, taken in connection with a smaller number of European experiments of a similar nature, serve to give us a fairly accurate idea of the relative proportions of the nutrients and energy in different food materials which the average person can utilize. Then there are the still more abstract researches with the respiration apparatus in Europe and the respiration calorimeter in this country. This

last investigation already includes 44 experiments with men, covering 132 days, in which an accurate account has been kept of the income and outgo of matter and energy under different conditions of diet and degrees of activity. These respiration experiments, and more especially those with the respiration calorimeter, serve to show more accurately than can be learned in any other way just how much nutrients and energy the body needs under different circumstances, how they are used, and how different food materials compare in nutritive value.

As the outcome of such inquiry in this country and the large number of investigations carried on elsewhere, we have to-day a fair understanding of the general principles of nutrition and of the ways of applying the results of experiment and experience in the study of the dietetics of public institutions. It is now possible to study rationally in prisons, hospitals, and orphanages the kinds, amounts, and cost of the food supplied, and to learn the physiological demands of the inmates; also to test the economy of the food supply as compared with the cost on the one hand and the needs of the persons to be nourished on the other. From the knowledge thus obtained it can frequently be shown where and how improvements may be made in the storing, cooking, and serving of the food, so as to render the diet more attractive, palatable, and, if necessary, better balanced and more nutritious, often at the same time reducing the cost. To state the case in another way, it has become possible to apply the methods and results of scientific inquiry in the dietary management of public institutions just as well as in the management of agricultural, manufacturing, and commercial enterprises.

Principles Underlying Inquiries Regarding Dietaries.

In efforts toward improvement of dietaries, especially in large institutions, the following principles are to be considered: (1) A certain amount of food is necessary for the maintenance of the body. (2) This food requirement differs with different conditions of age, sex, health, muscular activity, environment, etc., and is termed the physiological demand. (3) Dietary standards expressing the physiological demands are measured, not in quantities of food materials, as meat, bread, potatoes, and the like, but in quantities of nutrients and energy. (4) It is practically impossible to store, cook, and serve food without more or less shrinkage and waste, the quantity of food lost in these two ways depending upon its quality and upon the methods of storeroom, kitchen, and dining-room management. (5) To meet the needs of an institution the food supply must be enough to cover not only the physiological need of its population, but also the actual shrinkage and waste. (6) If more food than necessary is supplied, the kitchen and table wastes are likely to be increased, and there will also be a

tendency for the inmates of the institution to consume more food than is required to maintain them in health, thus entailing still further loss, to say nothing of the unnecessary tax upon the digestive system and the consequent injury to health; on the other hand, if the food supply is limited and the shrinkage and waste are large, the inmates may be underfed. (7) Pecuniary economy requires not only that there shall be a minimum of shrinkage and waste, but that the food shall be such as to furnish the needed nutriment at the lowest cost. (8) Hygienic economy requires not only that the food shall meet the physiological demands in respect to the quantities of nutrients and energy, but also that it shall be fitted to the digestive powers and other physiological peculiarities of the users; this is of special importance for invalids and young children. (9) The comfort and welfare of the users are promoted by making the food palatable and attractive.

PHYSIOLOGICAL DEMANDS OF DIFFERENT PERSONS.

It is often assumed that the appetite may be taken as a measure of food requirement, but in many cases it is a very unreliable criterion.

Excessive eating is not only a waste of food and, therefore, of money, but it is injurious to health. Physicians and hygienists are very generally of the opinion that a large proportion of the well-to-do people in this country eat more than is necessary, and this opinion is certainly borne out by figures for actual food consumption. On the other hand, there are many people, who, from lack of food or appetite, or for other reasons, do not eat as much as would be best for them. The above statements apply to people of sound mind, and perhaps, in still greater degree, to the insane. In feeding the insane it is frequently necessary to regulate the amount of food allowed individuals, otherwise some patients would eat more and others less than they need.

Dietary standards are commonly based upon the estimated physiological demands of persons of different age, sex, and occupation, and especially of different degrees of muscular activity. These estimates are in turn commonly based upon (1) actual food consumption, as shown by studies of dietaries, and (2) feeding experiments. Although much attention has been given to this subject, especially in Europe, the available data are not yet sufficient to make the results as accurate as is to be desired. The most reliable information comes from experiments in which the income of the body in terms of food and constituents is compared with the outgo in the products excreted by various channels, as the intestines, kidneys, lungs, and skin. By making such experiments with persons of different classes and under different conditions, and taking into account, with other things, the kind and amount of work done and the gain or loss of body material, we are able to

learn more or less exactly what the body needs and uses for its nourishment. The most valuable and, at the same time, the most difficult and costly experiments are those with the respiration calorimeter, which shows exactly how much nutrients and energy the subject actually requires under different conditions, and what are the value of different kinds of food for meeting those requirements.

STANDARDS FOR PERSONS UNDER ORDINARY CONDITIONS.

Different investigators have proposed various standards, which are alluded to further on. Those for "persons under ordinary conditions" were suggested by the writer, and they take into account the results of a large amount of inquiry both in this country and in Europe. Like similar standards of other investigators they are tentative and subject to revision as information is obtained.

The writer's standard for a man engaged in rather active muscular work calls for 125 grams of total or 115 grams of digestible (available) protein and 3,400 calories of available energy in the daily food. As compared with a man under such conditions, the relative amounts demanded by persons of different sex and different degrees of muscular activity are estimated as follows: Man with hard, muscular work, 1.2 times as much; man with light to moderate muscular work, 0.9 as much; man with sedentary work or woman with moderately active work, 0.8 as much; man with very little exercise or woman with light to moderate work, 0.72 as much (that is, 0.8 as much as a man at light to moderate muscular work, who in turn requires 0.9 as much as the man at moderately active work); woman with very little exercise, 0.64 as much (that is, 0.8 as much as a woman with moderately active work).

STANDARDS FOR PERSONS UNDER UNUSUAL OR ABNORMAL CONDITIONS.

Regarding the demands of those who live under abnormal conditions or whose bodily functions, either physical or mental, are deranged or enfeebled, we have little exact information. They may require more than similar persons under normal conditions, or they may require less. Concerning this matter, investigation is much needed. Several investigators, however, have studied the actual food consumption of inmates of prisons and insane hospitals, and noted whether their condition improves, grows worse, or remains the same, upon given diets. Tentative standards, based upon such observations, are given in the table on page 400. The variation in these estimates of food requirements are explained by the paucity of the data.

For regulating the diet of persons sound mentally but sick physically, standards are hardly possible; the judgment of a physician or other experienced person is the safest guide. The diet in hospitals can not be fixed with the same certainty as that for persons in health, because the requirements vary within wide limits.

Physiological Demands vs. Ration Allowance.

The actual food purchases in public institutions should be based upon the physiological demand of the inmates in so far as this can be determined, with such margin allowance as is necessary to cover the shrinkage and waste. The extent of this margin allowance will depend upon a variety of circumstances; even under the most favorable conditions it will usually be considerable, and in some csses it may be as much as 33 per cent. In other words, it will be necessary to purchase enough food, so that, allowing the proper margin for shrinkage and waste, one-tenth, one-fifth, or one-third, as the case may be, the amount actually eaten will satisfy the physiological demands. A careful watch kept in this direction will, in many instances, result in a considerable pecuniary saving.

Some of the more recent of the estimates of physiological demand or ration allowance are shown on page 399 and in the following table:

Class.	By whom proposed.	Total protein.	Digestible or available protein.[a]	Available energy or fuel value.[b]
Persons in health, under ordinary conditions.		*Grams.*	*Grams.*	*Calories.*
Man[c] at hard muscular work	Atwater[d]	150	138	4,350
Man[c] at moderately active muscular work	Atwater[d]	125	115	3,400
Man[c] with light muscular work	Atwater[d]	112	102	3,050
Man[c] with sedentary work	Atwater[d]	100	92	2,700
Man[c] with very little exercise	Atwater[d]	90	72	2,450
Inmates of prisons, insane hospitals, etc.				
Male[c] convicts at hard work	Dunlop[e]	150	138	3,380
Ordinary male[c] prisoners	Dunlop[e]	120	110	3,020
Prisoners and inmates of houses of correction, per person.	Richards[f]	103	95	2,765
Inmates of reformatories (male)	Richards[f]	111	102	3,000
Unemployed male[c] prisoners	Dunlop[e]	90	83	2,385
Inmates of almshouses, per person	Richards[f]	83	76	2,435
Punitive diet, short duration	Dunlop[e]	64	59	1,805
Punitive diet, long duration	Dunlop[e]	90	82	2,385
The insane, per person	Richards[f]	110	101	3,015
The insane, per person	Atwater[d]	85	78	2,450

[a] Assuming 92 per cent digestible—the average in ordinary mixed diet

[b] These figures are about 3 per cent smaller than have been given previously, the difference being due to the adoption of revised factors for calculations.

[c] Corresponding values for a woman are 0.8 as much.

[d] Figures represent physiological demand.

[e] Figures represent practically physiological demand, there being but an extremely small allowance for waste.

[f] Figures represent ration allowance, with margin for waste of about 10 per cent.

It will be noticed that the standard proposed by the writer for the average per capita inmates of insane hospitals is relatively small. It corresponds, however, quite closely with what might be expected from

the small amount of muscular activity of the majority of the inmates and from the fact that about half the inmates are women, requiring no more and often eating less than four-fifths as much food as men under like conditions.

The standards proposed by Mrs. Ellen H. Richards are based upon a margin allowance of 10 per cent on protein and carbohydrates, with no margin allowance on the fats. This corresponds to a margin allowance of about 7½ per cent on the energy, so that in order to represent estimates of actual physiological demands the figures in the table should be reduced by 10 per cent of the protein and 7½ per cent of the energy.

The values proposed by Dr. Dunlop refer, apparently, to nutritive ingredients actually furnished to the prisoners, with no margin allowance except for individual waste. They are based upon the supposition that the food requirements of inmates of penal institutions are not materially different from those of persons with similar amounts of muscular activity in ordinary walks of life.

Recent Studies of Dietaries in Public Institutions.

EUROPEAN INVESTIGATION.

It has already been intimated that a considerable amount of European investigation has been directed toward the study and improvement of dietaries of institutions.

The literature of prison dietaries is large. Some of the recent and more scientific investigations are worth especial attention. The method and results of such inquiry may be illustrated by reference to a recent investigation carried on among the Scotch prisons by Dr. J. C. Dunlop in 1898 and 1899. He was commissioned to report concerning the dietaries in use and to suggest desirable improvements. After a careful study of the rations actually consumed by the different classes of prisoners, he suggested certain changes, based upon what he considered the physiological demands of the inmates. Some of these suggestions were tested by actual trials with selected prisoners, and as the results seemed entirely satisfactory the suggestions were adopted. The improved rations were based not only upon differences in the amount of labor performed by different classes of the population of penal institutions, but upon differences in sex, body, weight, age, and climatic conditions. They apparently include little or no allowance for waste, and therefore represent very nearly the estimates of physiological demands. Some of these standards are given in the table on page 400.

INVESTIGATIONS IN THE UNITED STATES.

In this country there has been more or less sporadic interest in the improvement of dietaries of prisons and other public institutions, and

there are a number of early reports on the subject, but until recently there has been but little of the thorough, painstaking investigation which characterizes the studies into the food and nutrition of man carried on during the past eight years under the direction of the Department of Agriculture. Two recent investigations, however, deserve particular mention.

INQUIRIES IN PUBLIC INSTITUTIONS IN BOSTON.

In 1896 Mrs. Ellen H. Richards and Miss Sarah E. Wentworth were requested by the institutions' commissioner of Boston to investigate the food supplied at the public institutions in that city. The results obtained, showing the amounts of nutrients and energy supplied per person per day, were based upon the quantities of raw materials purchased during a given period and the average composition of similar materials. Certain modifications were suggested in the rations to replace those in actual use. These were based upon the probable physiological demands of the different classes of inmates, with margin allowance for waste, amounting to 10 per cent of the protein and about 7.5 per cent of the fat. Some of these rations are shown in the table on page 400.

INQUIRIES IN NEW YORK HOSPITALS FOR THE INSANE.

The most extensive inquiry into methods for the improvement of dietaries and dietetic management of public institutions thus far made in this country has been that instituted by the New York Commission in Lunacy among the hospitals for the insane in that State. This enterprise was placed in charge of the writer and prosecuted for some three years. The opportunity for a useful inquiry was unusually favorable. The results have been printed in the reports of the commission for 1897–1898, 1898–1899, and 1899–1900. As they are not yet widely known, explanation of the methods and results may not be out of place here.

The primary object of the inquiry was to establish a proper dietary standard, based, in so far as possible, upon the physiological needs of the hospital population. Other purposes were to study ways in which losses of food by shrinkage and waste in the storeroom, kitchen, and dining room might be reduced; to render the prescribed ration more flexible and at times more economical by suggesting ways in which one food material may be replaced by another without changing the nutritive value of the diet; to devise methods, if practicable, by which more palatable dishes may be prepared without increased cost, or equally attractive dishes at less cost; and, finally, to see how the diet in general may be best adapted to the health and comfort of both patients and employees. In carrying out the inquiry, two considerations, the welfare of the people in the hospital and the interests of the taxpayers, at whose expense they are supported, have been paramount.

The plan was to study the statistics of food supply in the hospitals; to find by weighings and measurements how much food is actually eaten by the different classes of the population; to examine into the methods of selection, handling, cooking, and serving the food; to make chemical analyses, when necessary, in order to learn the composition and nutritive values of the food materials; to employ skilled experts to examine into the best methods of cooking and of kitchen and dining-room management; to devise experiments upon the proper feeding of patients of different classes; and, finally, to learn how the proper officers and employees, and especially the chefs and cooks, may be best enabled and encouraged, not only to carry out, but also to devise, methods for improvement. More or less was done in all these directions. The accounts of the inquiry, results, and conclusions are given in three reports, filling in all nearly 1,000 pages.

The commission has stated the advantages derived from the inquiry, in an official summary, from which the following is taken:

As a result of this special work, we have now a definite idea of some of the good that has been accomplished, and we believe we are justified in expressing the following views:

First. The most important point has been the improvement in the food service, and this has been manifested in various ways. Under the stimulating influence of the work as conducted, the chefs and cooks have made a greater effort than ever before to prepare food in a more palatable form and in greater variety, with the effect of reducing the dining-room waste, as well as the kitchen waste, and thus making a saving in dollars and cents.

Second. We have found that economy results from using a larger variety of foods and foods that are better adapted to the various seasons of the year.

Third. With a knowledge of food values one can substitute various articles in the hospital dietary and thus promote economy. For instance, during the winter season, when eggs are expensive and sometimes poor, they can be omitted from the cooked dishes and at the same time skimmed milk from a creamery, when it is available, can be used in certain proportions in cooking.

Fourth. A comparative decrease in the cost of food has taken place, and this has not been due to the cutting down of food supplies, but rather as a result of care in utilizing every article that goes into the kitchen. One of the greatest savings came from the judicious use of left-over food. * * * We find that a comparison of food supplies as paid for in estimate No. 3 shows [in one of the hospitals] a yearly per capita reduction of $2.19, which, being multiplied by the average population for the year ending September 30, 1900, namely, 1,565.5, shows a total saving of $3,417. * * * This in spite of the fact that a great many articles of food were higher in price than they were during the preceding year.

Dr. A. W. Hurd, superintendent of the Buffalo State Hospital for the Insane, has favored the writer with an account of some things which he has observed in his own institution during the past three years as an outcome of the inquiries above referred to.

At the outset, the attention of officers and employees was directed to the amount of waste, and also to the possibilities of improvement in some of the details of the cooking and serving of food. The books of the hospital show a very material reduction in the per capita cost of

the food since the beginning of the investigations. This saving, as based upon the per capita cost of the first year, is estimated by Dr. Hurd as 13.7 per cent. What makes this reduction the more striking is the fact that it has been effected notwithstanding a material advance in the price of a considerable number of the food materials. At the same time there has been an improvement in the diet as a whole. One feature has been the addition to the diet of the attendants of so-called "extras," which include fried ham, cold meat, muffins, beef hash, coffee cake, potatoes, fried eggs, toast, fruit sauce, buns, etc. The diet for the inmates is such as may be ordinarily found in a well-managed institution.

Dr. Hurd, in speaking of the improved methods in the hospital, says that "while we can not say that all this is due entirely to the food investigations, and while some of it is due to care and vigilance in buying, yet we think a great deal of it is attributable to the extra care and attention which have been paid to the cooking, distributing, service, and prevention of waste which are the outcome of the investigations."

Of the share of the hospital in the inquiry, Dr. Hurd says: "The cooperation in this work has not been a burden or drag on the institution, but has, we think, resulted in a direct benefit to the dietary of the inmates, the satisfaction and contentment of all concerned, and has been a marked source of economy."

A large part of the saving in cost, while the diet has been improved, Dr. Hurd attributes to the reduction in the waste of food.

It is to be remembered that the favorable results thus reported by the authorities represent only the first steps in an improvement. This improvement can be made not only permanent but increasingly effective, in proportion as governing boards, officers, and employees understand better and better the underlying principles, the ways in which they may be applied, and the usefulness of the results.

Threefold Advantage of Dietary Inquiries.

There are three ways in which dietary inquiries may be made practically useful. These have to do with the physiological, the pecuniary, and the humanitarian aspects of the subject.

ESTABLISHMENT OF DIETARY STANDARDS.

What has been said regarding the physiological need will suffice to show that the per capita demands for food in an institution will vary according to the character and activity of the inmates. Prisoners at more or less active labor, patients in hospitals for the insane, the inmates of almshouses, and children in orphanages have very different demands for nutriment. This means that the physiological standard which must serve as the basis for the ration allowance should be

fitted to the specific demands of the particular class of people in the institution. The only way to find what is the proper physiological standard is by the actual test of dietary studies and feeding experiments.

As the result of 56 dietary studies in the New York Hospital for the Insane it was found that, taking the inmates as a whole, the food actually eaten furnished, on the average, not far from 75 grams of protein and 2,300 calories of energy per person per day. The averages for the food of different classes ranged from 48 grams of protein and 1,600 calories of energy for women of the "infirm" class and 64 grams of protein and 2,170 calories of energy for men of the same class to 53 grams of protein and 1,870 calories of energy for the "restless, active, disturbed" women and 95 grams of protein and 2,840 calories of energy for the workingmen.

The inquiry was not carried far enough to definitely establish physiological standards for the different classes or for the inmates as a whole. For such exact standards feeding experiments would be necessary. These would not be difficult, and, although they would require much time and prove expensive, they would many times repay their cost.

With the information actually gained, however, the writer felt warranted in proposing a tentative physiological standard for the whole number of inmates of 85 grams of protein and 2,450 calories of energy per person per day, as stated above. This, it will be observed, was 13 per cent larger in protein and 4 per cent larger in energy than the actual food consumption. It is not intended to imply by this that the people did not eat enough; indeed, there is no reason for assuming that they were in any way underfed, but the experiments were not carried far enough to absolutely demonstrate that a larger food ration than that actually consumed might not in some cases have been better; so, in setting up a standard which might not be exact, it seemed best to err on the side of liberality.

PECUNIARY ASPECT OF THE SUBJECT.

To get the ration allowance, that is, the food that is to be actually supplied by the institution, we must add to the physiological demand a certain amount to cover shrinkage and waste. This brings out very clearly the financial side of the subject.

More or less waste is unavoidable. When one examines into the subject carefully it is surprising to see in how many ways waste may occur not only in public institutions but in private families. Even when there is no apparent carelessness in the management of the storeroom, kitchen, and dining room, improvements may often be suggested. The small wastes are numerous and sum up large amounts. The amount of waste in households has been found to vary from practically nothing to as much as 8 or 10 per cent of the whole food,

according to the management, the time of year, the class of foods purchased, and the pecuniary necessities of the family; while in boarding houses, even under ordinary economy, it has reached in individual instances as much as 20 per cent in actually observed cases. In public institutions the tendency to waste is in some respects greater than in private families and small boarding houses. Often the left-over food is not as easily utilized in institutions as in private families, owing to the lack of kitchen service and a quite common feeling of aversion to "made-over" dishes. The shrinkage in the storeroom, due to the large amount of food material which must be kept on hand, is also greater in institutions than in private families. Vegetables decay, meats spoil, and in numerous other ways wastes, apparently not large in themselves, occur. Often much of the waste is due to carelessness in the kitchen. The equipment of the kitchen also has more or less to do with the amount of waste; the poorer the equipment the larger is likely to be the proportion of food that goes to feed farm animals.

The dietary studies in the New York hospitals, according to the official record supplied at the beginning of the inquiry, showed that the nutrients and energy in the food eaten were only about two-thirds of the amount in the food purchased. This implies that one-third of the actual nutriment of the food was utilized only in so far as the table and kitchen wastes were fed to animals. The amounts may not be entirely correct, but they can hardly be very far out of the way.

Now, these institutions were well managed. The waste of food was no larger, it is believed, than is entirely natural unless specific attention is given to this particular subject. As soon as the facts were known steps were taken to reduce the waste, which resulted in marked pecuniary saving. What was wanted here was simply to have the actual facts brought out. The improvements followed naturally.

One of the most notable changes that is taking place of late in our great business enterprises is the introduction of methods for economizing. With the severe competition of the present time this makes the difference between profit and loss in thousands of instances. Exactly the same principle applies in the dietary management of public institutions.

The annual cost of the food supplied to the New York State Hospital at the present rate is about $1,125,000. Taking the estimated loss by shrinkage and waste as one-fourth instead of one-third it would amount to $281,000. A large part of this is unavoidable, but a saving of only 5 per cent in the whole cost of the food would amount to $56,000.

HUMANITARIAN ASPECTS OF THE SUBJECT.

The reduction of cost is not the only object, nor indeed should it be the chief object, of dietary inquiries. The humanitarian considerations should be uppermost. In prisons and reformatories it may

be proper at times to make the diet one of the punitive agencies. But not all prisoners require or are benefited by such means. Some can be reformed, and there are cases in which the diet may be used as an agency to that end by making it agreeable, thus encouraging honest effort to improve.

In such institutions as hospitals and almshouses the argument for palatable and attractive food is still stronger. Some of the inmates of hospitals for the insane may be cured. Whatever can be done to facilitate their cure is certainly desirable. Of the incurables, a large number still have a keen appreciation of the comforts and discomforts of their situation. To do away so far as possible with their discomforts and to provide the things which contribute to their happiness is our plainest duty. The same is true, perhaps in still greater degree, of patients in hospitals for the sick, while it is hardly less true of the unfortunates in almshouses, and certainly if there is any class which appeals to every instinct of charity and benevolence it is the children who, in lack of parental care, are made the wards of the public.

If the judgment of many of those who are familiar with the management of such institutions is to be accepted, the opportunities for dietary improvement are often great, and in some cases they are most urgently demanded. One of the encouraging features of modern philanthropy is found in the increased attention given to such considerations as these in the care of the delinquent and dependent classes.

One part of the work in the New York hospitals, as already stated, consisted in a definite effort toward improvements in kitchen and dining-room management, including especially the cooking. Experts were employed who were familiar with such establishments, who were skilled in cooking, and well informed as to the nutritive value of food. They were able to devise dishes appropriate to the wants of the different classes of the hospital population, attractive both to the palate and to the eye, and at the same time economical as regards the cost of material and labor. Some of these were "made-over" dishes, so that a double object was gained—the improvement of quality and the reduction of expense. The influence of the experiments upon the chefs, the cooks, and the kitchen and dining-room management generally was most helpful.

What was thus done in a few institutions can be done in many such where large numbers are fed, and not the least advantage of each improvement will be the encouragement to still further progress.

Dietetics in Educational Institutions.

In treating of the need of dietary improvement in public institutions very little has been said concerning what may be done in boarding houses connected with educational institutions. The opportunities

for both investigation and improvement in such establishments is very considerable. The subject is well worthy the attention of managers, teachers, boards of trustees, and benefactors of such institutions.

The Need of Experts—A New Profession for Women.

From the foregoing it will be seen that there is still need of dietary improvement; but in order to bring this about experts are required. These should be not mere cooks, or even chefs, but persons with thorough scientific and practical training. The calling is especially appropriate for women who have the natural gifts and the opportunities to secure the necessary education. A lady well known throughout the United States as a leader in the higher education of women has a list of no less than twenty institutions in which women of the character and training just mentioned are wanted. It is scarcely going too far to say that a new profession for women is opening in this direction.

Conclusion.

In conclusion, it may be observed that improvement in dietaries must be gradual, and of necessity must require long continued experiment and observation. Methods of experimenting and practical application of the results can be gradually developed in institutions themselves, so that their own officers and employees will be able to accomplish the desired object in the most economical, useful, and satisfactory ways. The larger investigations into the food and nutrition of man, which have been and are being carried on under the auspices of the Department of Agriculture and in cooperation with scientific, educational, and philanthropic institutions in different parts of the country, have laid a foundation for inquiries such as could not otherwise be obtained without large expenditure of labor and money.

The subject of dietetics in our public institutions is worthy of much more careful study than it has thus far received. The time is ripe for scientific investigation and the practical application of the results. The outcome could hardly fail to be of advantage as well to the public who support the institutions as to those who make up what we call the dependent and delinquent classes. The prisoner whom in justice we restrain and endeavor to reform, the sick, the poor, whose lives we strive to make less unhappy, the orphan whom we desire to rear into useful citizenship, the taxpayer whose burden we desire to relieve—in the interest of all of these such inquiries are called for.

GOVERNMENT COOPERATION IN OBJECT-LESSON ROAD WORK.

By Martin Dodge,
Director of the Office of Public Road Inquiries.

INTRODUCTION.

In a government having a composite nature like that of the United States it is not always easy to determine just what share the General Government, the State government, and the local government should respectively take in carrying out highway work, though it is generally admitted that there should be cooperation among them all.

PAST WORK OF NATIONAL GOVERNMENT IN CONSTRUCTION OF HIGHWAYS.

In the early history of the Republic the National Government itself laid out and partially completed a great National system of highways connecting the East with the West and the capital of the nation with its then most distant possessions. Fourteen million dollars in all was appropriated by acts of Congress to be devoted to this purpose, an amount almost equal to that paid for the Louisiana Purchase. In other words, it cost the Government substantially as much to make that territory accessible as to purchase it; and what is true of that territory in its larger sense is also true in a small way of nearly every tract of land that is opened up and used for the purposes of civilization, that is to say, it will cost as much to build up, improve, and maintain the roads of any given section of the country as the land in its primitive condition is worth; and the same rule will apply in most cases after the land value has advanced considerably beyond that of its primitive condition. It is a general rule that the suitable improvement of a highway within reasonable limitations will double the value of the land adjacent to it. Seven million dollars, half of the total sum appropriated by acts of Congress for the National road system, was devoted to building the Cumberland Road from Cumberland, Md., to St. Louis, Mo., the most central point in the great Louisiana Purchase, and 700 miles west of Cumberland. The total cost of this great road was wholly paid out of the United States Treasury, and though never fully completed on the western end, it is the longest straight road ever built by any government. It passes through the capitals of Ohio, Indiana, and Illinois, and the cost per mile was, approximately, $10,000. It furnishes the only important instance the country has ever had of

the General Government providing a highway at its own expense. The plan, however, was never carried to completion, and since its abandonment two generations ago the people of the different States have provided their own highways. For the most part they have delegated their powers either to individuals, companies, or corporations to build toll roads, or to the minor political subdivisions and municipalities to build free roads.

RESOURCES OF LOCAL GOVERNMENTS INSUFFICIENT FOR ROAD WORK.

With the passing of the toll-road system, the withdrawal of the General Government from the field of actual road construction, and the various State governments doing little or nothing, the only remaining active agent occupying the entire great field is the local government in each community, and while these various local governments have done and are still doing the best they can under the circumstances, there is great need that their efforts should be supplemented, their revenues enlarged, and their skill in the art of road construction increased.

The skill of the local supervisor was sufficient in primitive times, so long as his principal duties consisted in clearing the way of trees, logs, stumps, and other obstructions, and shaping the earth of which the roadbed was composed into a little better form than nature had left it; and the resources at his command were sufficient so long as he was authorized to call on every able-bodied male citizen between 21 and 45 years of age to do ten days' labor annually on the road, especially when the only labor expected was that of dealing with the material found on the spot. But with the changed conditions brought about by the more advanced state of civilization, after the rights of way have been cleared of their obstructions and the earth roads graded into the form of turnpikes, it became necessary to harden their surfaces with material which often must be brought from distant places. In order to accomplish this, expert skill is required in the selection of materials, money instead of labor is required to pay for the cost of transportation, and machinery must be substituted for the hand processes and primitive methods heretofore employed in order to crush the rock and distribute it in the most economical manner on the roadbed. Skill and machinery are also required to roll and consolidate the material so as to form a smooth, hard surface and a homogeneous mass impervious to water.

The local road officer now not only finds himself deficient in skill and the proper kind of resources, but he discovers in many cases that the number of persons subject to his call for road work has greatly diminished. The great cities of the North have absorbed half of the population in all the States north of the Ohio and east of the Mississippi, and those living in these great cities are not subject to the

former duties of working the roads, nor do they pay any compensation in money in lieu thereof. So the statute labor has not only become unsuitable for the service to be performed, but it is, as stated, greatly diminished. In the former generations substantially all the people contributed to the construction of the highways under the statute labor system, but at the present time not more than half the population is subject to this service, and this, too, at a time when the need for highway improvement is greatest.

NECESSITY OF A GENERAL FUND FOR THE CONSTRUCTION OF HIGHWAYS.

While the former ways and means are inadequate or inapplicable to present needs and conditions, there are other means more suitable for the service, and existing in ample proportion for every need. The toll-gate keeper can not be called upon to restore the ancient system of turnpikes and plank roads to be maintained by a tax upon vehicles passing over them, but there can be provided a general fund in each county sufficient to build up free roads better than the toll roads and with a smaller burden of cost upon the people. The statute labor in the rural districts can not be depended upon, because it is unsuitable to the service now required and spasmodic in its application, when it should be perennial; but this statute labor can be commuted to a money tax, with no hardships upon the citizens and with great benefit to the highway system.

Former inhabitants of the abandoned farms or the deserted villages can not be followed to the great cities and the road tax which they formerly paid be collected from them again to improve the country roads; but it can be provided that all the property owners in every city, as well as in every county, shall pay a money tax into a general fund, which shall be devoted exclusively to the improvement of highways in the rural districts. The State itself can maintain a general fund out of which a portion of the cost of every principal highway in the State shall be paid, and by so doing all the people of the State will contribute to improving the highways, as they once did in the early history of the nation, when substantially all the wealth and population was distributed almost equally throughout the settled portions of the country.

Having a general fund of money instead of statute labor, it would be possible to introduce more scientific and more economical methods of construction with cooperation. This cooperation, formerly applied with good results to the primitive conditions, but which has been partially lost by the diminution in the number and skill of the coworkers, would be restored again in a great measure by drawing the money with which to improve the roads out of a general fund to which all had contributed.

BENEFITS OF EMPLOYING PRISONERS IN HIGHWAY WORK.

In many countries the army has been used to advantage in time of peace in building up and maintaining the highways. There is no army in this country for such a purpose, but there is an army of prisoners in every State, whose labor is so directed, and has been so directed for generations past, that it adds little or nothing to the common wealth. The labor of these prisoners, properly applied and directed, would be of great benefit and improvement to the highways, and would add greatly to the National wealth, while at the same time it would lighten the pressure of competition with free labor by withdrawing the prison labor from the manufacture of commercial articles and applying it to work not now performed, that is, the building of highways or preparing material to be used therefor. Pl. LIII, fig. 1, shows prisoners employed in preparing material for the object-lesson road at Asheville, N. C.

PRESENT WORK OF THE NATIONAL GOVERNMENT IN ROAD CONSTRUCTION.

The General Government, having withdrawn from the field of road construction in 1832, has since done little in that line until very recently. Eight years ago Congress appropriated a small sum of money for the purpose of instituting a sort of inquiry into the prevailing condition of things pertaining to road matters. This appropriation has been continued from year to year and increased during the last two years with a view of cooperating to a limited extent with other efforts in road construction.

The General Government can perform certain duties pertaining to scientific road improvement better than any other agency. Scientific facts ascertained at one time by the General Government will serve for the enlightenment of the people of all the States, and with no more cost than would be required for each single State to make the investigation and ascertain the facts for itself.

ESTABLISHMENT OF LABORATORY FOR TESTING ROAD MATERIALS.

With a view to securing scientific facts in reference to the value of road-building materials, the Secretary of Agriculture has established at Washington, D. C., a mechanical and chemical laboratory for testing such material from all parts of the country. Prof. L. W. Page, late of Harvard University, is in charge of this laboratory, and has tested many samples of rock without charge to those having the test made There is, however, no test equal to the actual. application of the material to the road itself.

COOPERATION IN BUILDING OBJECT-LESSON ROADS.

With a view to making more extensive tests than could be done by laboratory work alone, the Director of the Office of Public Road

Inquiries has during the past two years cooperated with the local authorities in many different States in building short sections of object-lesson roads. In this work it is intended not only to contribute something by way of cooperation on the part of the General Government, but also to secure cooperation on the part of as many different interests connected with the road question as possible. The local community having the road built is most largely interested, and is expected to furnish the common labor and domestic material. The railroad companies generally cooperate, because they are interested in having better roads to and from their railroad stations. They therefore contribute by transporting free or at very low rates the machinery and such foreign material as is needed in the construction of the road. The manufacturers of earth-handling and road-building machinery cooperate by furnishing all needed machinery for the most economical construction of the road, and in many cases prison labor is used in preparing material which finally goes into the completed roadbed. The contribution which the General Government makes in this scheme of cooperation is both actually and relatively small, but it is by means of this limited cooperation that it has been possible to produce a large number of object-lesson roads in different States. These have proved very beneficial, not only in showing the scientific side of the question, but the economical side as well.

In the year 1900 object-lesson roads were built under the direction of the Office of Public Road Inquiries near Port Huron, Saginaw, and Traverse City, Mich.; Springfield, Ill.; and Topeka, Kans. Since that time the object-lesson roads so built have been extended and duplicated by the local authorities without further aid from the Government. The people are so well pleased with the results of these experiments that they are making preparations for additional extensions, aggregating many miles.

During the year 1901 sample object-lesson roads were built on a larger scale in cooperation with the Illinois Central, Lake Shore, and Southern railroad companies and the National Association for Good Roads in the States of Louisiana, Mississippi, Tennessee, Kentucky, Illinois, New York, North Carolina, South Carolina, Alabama, and Georgia. In all of these cases the cooperation has been very hearty on the part of the State, the county, and the municipality in which the work has been done, and the results have been very satisfactory and beneficial. (Pl. LIII, fig. 2, and Pl. LIV.)

IMPORTANCE OF GOOD ROADS.

The Hon. A. H. Longino, governor of Mississippi, in his speech made at the International Good Roads Congress at Buffalo, September 17, 1901, said:

My friends, the importance of good roads seems to me to be so apparent, so self-evident, that the discussion thereof is but a discussion of truisms. Much as we appreciate railroads, rivers, and canals as means for transportation of the commerce of the country, they are, in my judgment, of less importance to mankind, to the masses of the people, and to all classes of people, than are good country roads.

I live in a section of the country where that important subject has found at the hands of the people apparently less appreciation and less effort toward improvement than in many others. In behalf of the Good Roads Association, headed by Colonel Moore and Mr. Richardson, which recently met in the State of Mississippi, I want to say that more interest has been aroused by their efforts concerning this important subject among the people there than perhaps ever existed before in the history of the State. By their work, demonstrating what could be done by the methods which they employed, and by their agitation of the question, the people have become aroused as they never were before; and since their departure from the State a large number of counties which were not already working under the contract system have provided for public highways, worked by contract, requiring the contractor to give a good and sufficient bond, a bond broad enough in its provisions and large enough in amount to compel faithful service; and Mississippi is to-day starting out on a higher plane than ever before.

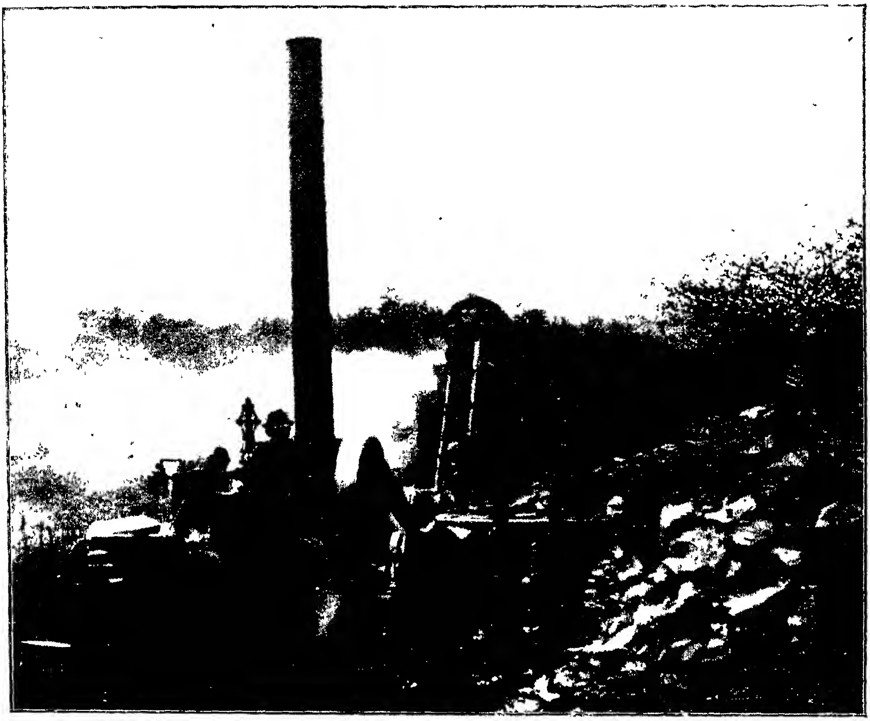


FIG. 1.—UTILIZING CONVICT LABOR IN THE PREPARATION OF ROAD MATERIAL FOR OBJECT-LESSON ROAD AT ASHEVILLE, N. C.

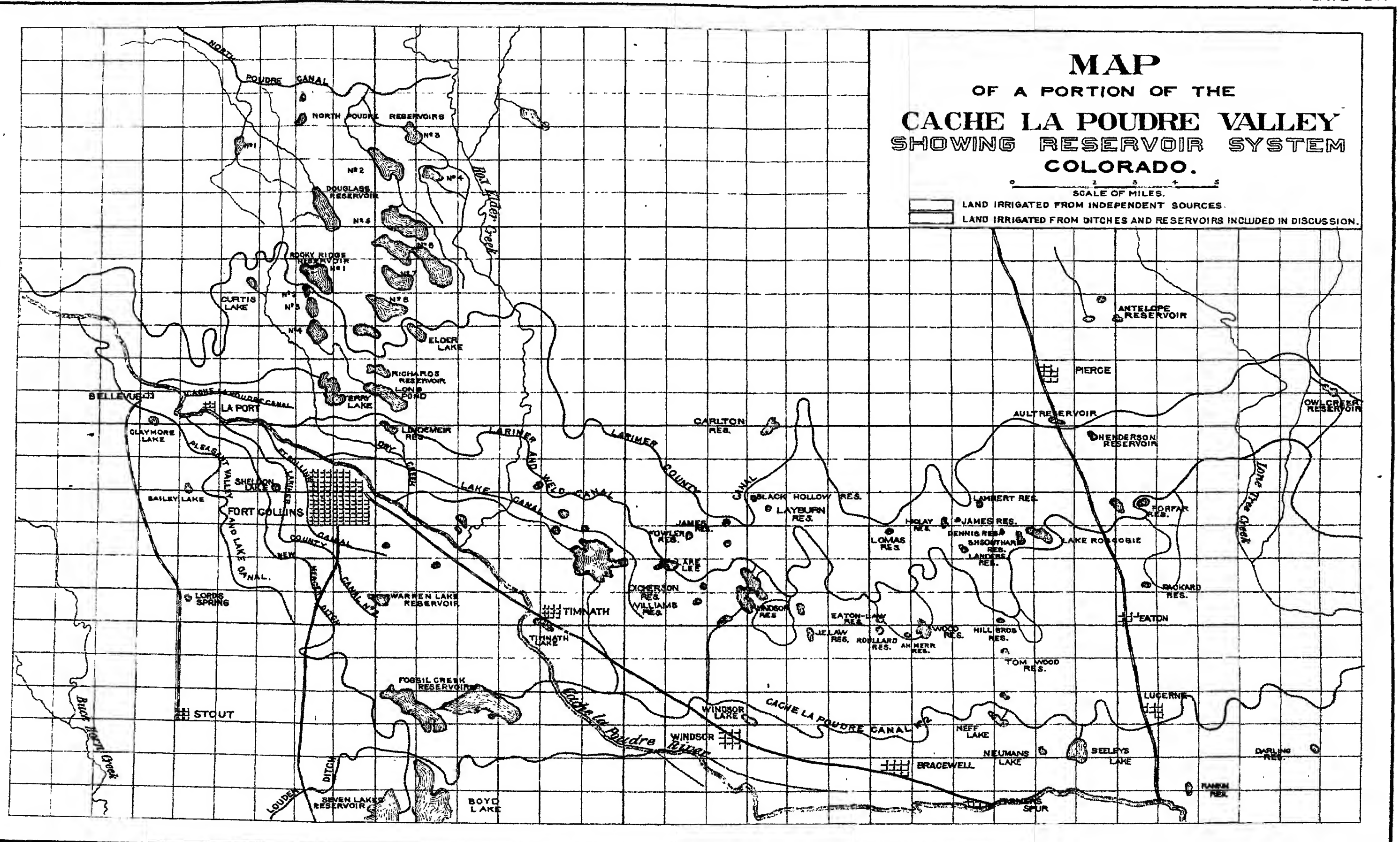
FIG. 2.—OBJECT-LESSON MACADAM ROAD AT ASHEVILLE, N. C.

[This road was built through the cooperation of the Office of Public Road Inquiries, the National Good Roads Association, the Southern Railway, the road-machine companies, and the people of Asheville and vicinity.]

FIG. 1.—SOUTHERN RAILWAY GOOD ROADS TRAIN AND SOME ROAD EXPERTS.

FIG. 2.—OBJECT-LESSON MACADAM ROAD AT GREENEVILLE, TENN.

[This road was built through the cooperation of the Office of Public Road Inquiries, the National Good Roads Association, the Southern Railway, the road-machine companies, and the people of Greeneville and vicinity.]



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SOME TYPICAL RESERVOIRS IN THE ROCKY MOUNTAIN STATES.

By Elwood Mead,
Irrigation Expert, in Charge of Irrigation Investigations, Office of Experiment Stations.

INTRODUCTION.

During the two years ended December 1, 1900, there were issued permits for the construction of reservoirs as follows: By the State engineer of Colorado, 147; by the State engineer of Wyoming, 77. The fact that surveys, plans, and estimates for 224 of these works have been made in two States in two years shows that activity in reservoir construction is not confined to efforts to secure Government aid, but that large sums of money are being expended in the construction of private reservoirs.

An inquiry into this subject reveals a potent cause for this activity. Reservoirs are being built because those now in operation are profitable. These have paid their builders, and are benefiting the communities they serve in a surprising degree.

It is the purpose of this paper to describe some typical reservoirs of the Rocky Mountain States to show how widely they differ from the usual idea that a reservoir requires a lofty dam across a remote and precipitous mountain canyon. The operation of these reservoirs will also be outlined in order to show when they are filled, when the water is used, and the benefits derived from them.

The valley of the Arkansas River in Colorado and Kansas has some of the largest and best examples of private irrigation reservoirs with which the writer is familiar, and the operation of the Twin Lakes Reservoir, on the headwaters of the Arkansas, has been particularly interesting and instructive. Here the water is stored in the mountains, carried down in the river to the plains, and there disposed of to settlers under canals built before the reservoir was seriously thought of. The reservoir systems of the Poudre and Big Thompson valleys in Colorado and the Canyon Creek Reservoir in Utah have been selected for description, because nearly all of them are cooperative enterprises, built and owned by the farmers using their water. With two exceptions, they belong to the class of storage works suited to private ownership, and illustrate, therefore, a kind of development which ought to be encouraged.

LOCATION AND EXTENT OF RESERVOIR SYSTEMS OF THE POUDRE AND BIG THOMPSON VALLEYS IN COLORADO.

A stranger traveling through the irrigated valleys of the Poudre and Big Thompson rivers in Colorado, if he ignored the mountain background, might readily imagine himself in the lake region of Minnesota or Wisconsin. There is nothing in the surrounding country to suggest aridity, but exactly the reverse. The cultivated fields show no lack of moisture, while the district is dotted in every direction by lakes and ponds. Surrounded by prosperous and highly cultivated farms, with margins bordered by trees and bushes, these bodies of water form an attractive feature of the landscape. They harmonize so well with their surroundings and have such an appearance of age and stability that one can hardly realize that they are all the results of the work of farmers, and that a quarter of a century ago none of them were in existence.

Most of these basins are irrigation reservoirs. From them hundreds of farmers draw their water supply during the latter part of the summer. Without them the most valuable crops could not be grown. They are as essential to the success of irrigation as the canals or laterals which distribute water, and their construction has proven far more profitable. There are 27 of these artificial lakes under the ditches of the Poudre Valley and 34 under the Big Thompson ditches. The maps of part of the Poudre Valley (Pl. LV) and of part of the Big Thompson district (Pl. LVI) show where these reservoirs are located and the land they water. They vary in size from 20 to 700 acres, and cover in the aggregate a considerable percentage of the irrigated territory. Those in the Poudre Valley cover altogether 4,969 acres, or about 1 acre in 35 of the land under cultivation, and hold 54,683 acre-feet,[1] or water enough to cover all the land now being irrigated to a depth of almost 4 inches. The reservoirs in the Big Thompson Valley occupy about 1 acre in 40 of the irrigable land, and out of the 34, 25 store 45,000 acre-feet of water, or more than enough to cover the whole irrigated district to a depth of 6 inches.

WHY THE POUDRE AND BIG THOMPSON RESERVOIRS WERE BUILT.

At the outset the farmers of these valleys irrigated directly from the rivers. When their natural flow filled the canals, the farmers had abundant harvests; when the rivers ran dry, the farmers saw their crops wither and perish, but this latter was rarely the case at first. Wheat and native hay were the leading crops, and as these were irrigated while the mountain snows were melting and the rivers were high there were few complaints of drought. All this was changed when wheat farming gave way to diversified crops, and alfalfa and

[1]An acre-foot is 43,560 cubic feet, or water sufficient to cover an acre of land to the depth of 1 foot.

potatoes became important products. Then water for late irrigation became a paramount necessity, and the natural flow of these streams failed to supply the demand. When the snows on the mountains disappeared, the water in these streams shrank, not slowly, but suddenly. The irrigator who quit work on Saturday night with all the water he needed often found when he attempted to resume his labors Monday that his ditch was empty. After July 15 the early appropriators controlled both rivers. There was not enough left for later appropriators to keep alive the shade trees and orchards, much less to mature their crops or even the more valuable products. Farmers, as they looked upon their parched fields, thought regretfully of the water which had run to waste a few days before, and realized that their losses were not due to a scanty supply, but to its faulty distribution. To remedy this, the floods had to be held back until they were needed, and farmers began to provide for this.

In order to do this it was not necessary to explore the mountains for reservoir sites and build costly dams across canyons. Nature had made ready for this need when it should appear by providing storage sites amidst the fields where the water was to be used. These valleys, like all the country along the eastern base of the Rocky Mountains, slope away from the mountains with a fall varying from 10 to 25 feet per mile. Scattered over this incline are depressions which can be filled from the canals which cross the slope above them and be emptied by means of cuts or tunnels on the lower side. Some of these basins have natural outlets which have to be dammed (Pl. LVII). Where a reservoir outlet is too low to irrigate the lands of its owners, an exchange is made with the holder of early appropriations, giving the stored water for an equal volume from the stream. The upper canals fill the reservoirs and the lower canals take the water from these reservoirs in times of shortage, leaving the water of the stream to the upper canals. Such is a brief outline of the system. The large number of separate reservoirs it includes prevents describing each one separately. Those selected are among the more important.

TYPICAL RESERVOIRS OF CACHE LA POUDRE VALLEY.

THE LARIMER AND WELD RESERVOIR.

This reservoir covers 470 acres, is 31 feet deep, and holds 6,887 acre-feet of water. It is owned by a stock company composed of some of the landowners under the Larimer and Weld Canal. There are 186 shareholders, each owning 4 shares of stock. These 4 shares constitute one right, which is supposed to irrigate 25 acres.

The original cost of the reservoir was $69,978.31, or almost $365 a right. The rights are now worth $1,200 each. To maintain this reservoir costs about $600 a year. Construction began May 15, 1891, and

the reservoir was enlarged in the fall of 1894 to its present capacity. Its owners began to fill it for the season of 1901 in October, 1900, and completed the filling during the spring floods of May and June, 1901. By July 1 the reservoir was full. The use of water from it began August 3, and continued at intervals until September 10, when the reservoir was emptied. The water was used for the irrigation of potatoes and sugar beets, and without it there would have been no crop of either under this canal. When water is discharged from the reservoir the volume is measured by a weir in the outlet ditch. It is then measured to the owners of the rights by means of a weir in each lateral.

The original outlet of this basin has been closed by an embankment 1 mile long and 12 feet high. This embankment is of earth, 15 feet wide on top, with slopes inside and outside of 3 to 1. The inside slope is riprapped with flat stone. When the embankment was built the site was plowed, so that the new earth would join properly with the natural surface. The bank was then built in layers by scrapers and teams, each layer being well tamped. At the foot of the embankment on the inside of the reservoir the natural soil was plowed out and the hollow filled with fresh earth. This was done to close all prairie-dog holes and to more effectively prevent seepage.

The outlet works are built on a slate foundation. They consist of 65 feet of stone arch in front of the gate well and 100 feet of concrete pipe behind it. The stone arch is built on a concrete base, and the well is 36 feet deep. Behind the well are two 35-inch cement pipes, 100 feet long, laid side by side, 8 inches apart, with 8 inches of concrete over and around them, and there is a stone collar built around the pipes every 20 feet. As a further precaution against seepage, the wall just back of the gates was extended for 50 feet on each side. For 20 feet on each side it was founded on the natural slate. After that the trench was not dug so deep. The gates are of oak, 42 inches square and 4 inches thick. They are raised by screws threaded 4 threads to the inch. These gates leak a little while they are being set, but after the water is drawn off for the season care is taken to see that they set properly, and they soon become tight.

CACHE LA POUDRE RESERVOIR.

This reservoir covers 600 acres, is 32 feet deep, and holds 8,934 acre-feet of water. It was filled last winter between November and June. The reservoir is owned by the people who use the water, and who have been incorporated as a company, with 375 water rights. Thirty-five rights belong to the Lake Canal Company stockholders. The rest are used in Cache la Poudre Canal No. 2. This canal supplies water to 30,000 acres of land. The reservoir water is used between July 15 and September 30. Without it this year there would have been no potato crop and the third crop of alfalfa would have been short.

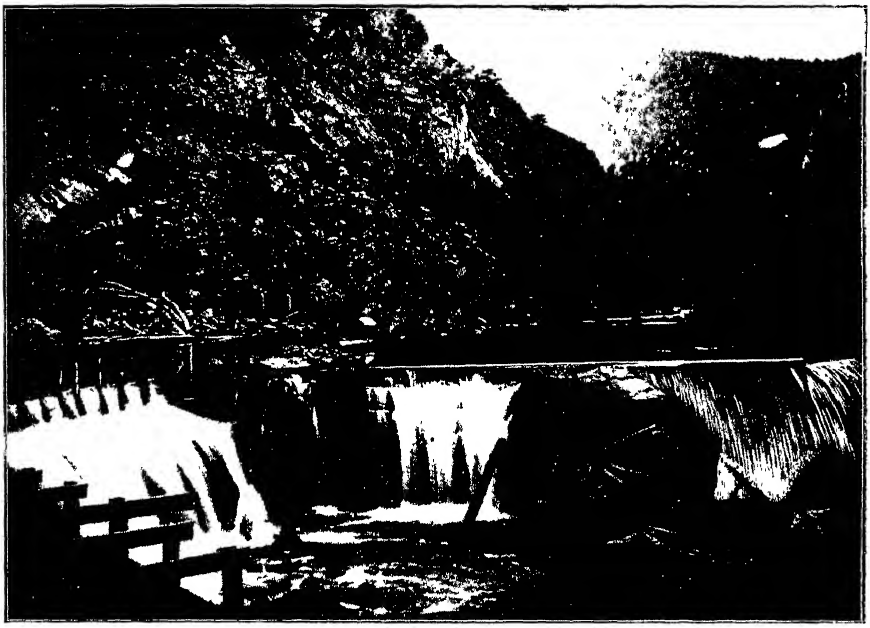


Fig. 1.—Dam and Headworks of Handy Ditch, Big Thompson River, Colorado.

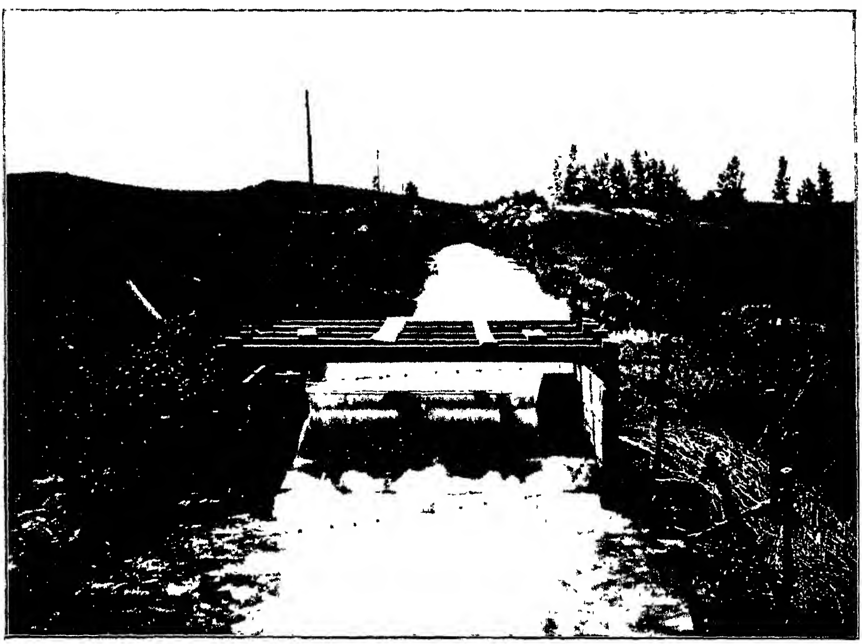


Fig. 2.—Weir in Outlet of Lone Tree Reservoir, Colorado.

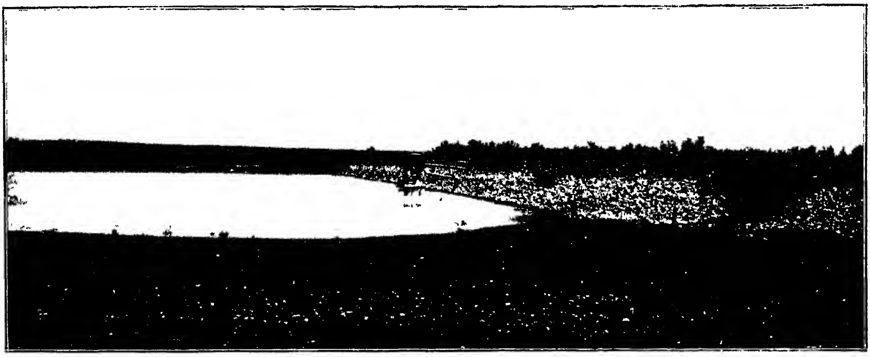


FIG. 1.—WINDSOR RESERVOIR, COLORADO.

FIG. 2.—LAKE LOVELAND RESERVOIR, COLORADO.

FIG. 3.—BEASLEY RESERVOIR AND OUTLET, COLORADO.

From the river alone only the grain crops and two crops of alfalfa could have been brought to maturity. The manager of the canal estimates that the reservoir was worth this year to the farmers under it $500,000.

The original cost of the reservoir was $105,000. It is valued at $200,000. To operate and maintain it costs $1,000 a year. It has been in operation since 1892. In running the water out of the reservoir a weir at the outlet measures the total flow, and each farmer has a measuring weir in his own lateral.

There are two embankments—one 2,000 feet long and 16 feet high, the other one-half mile long and 36 feet high. Both are 16 feet wide at the top, with slopes of 2 to 1 on the outside and 3 to 1 on the inside. The inside slopes are covered with 2 feet of gravel and then riprapped with stone to at least 1 foot in thickness. The outlet is located at the deepest portion of the highest embankment. In building this bank a trench 1,000 feet long and 6 feet deep was excavated as a precautionary measure. It was made wide enough for a team to work in, and filled with better material before the bank was built above it.

The outlet is on marshy ground and required considerable care in construction. A trench was dug the entire length of the outlet conduit; it was 190 feet long, 14 feet wide, and 9 feet deep, except at the apron and approach, where it was made 20 feet wide. Clean cobblestones were put into the trench to a depth of 2 feet; these were hammered down well with mauls, then thoroughly slushed with mortar, one part cement to four parts sand. On this foundation rubble masonry was built 5½ feet thick, carefully laid in mortar, and slushed every foot of height, so as to be sure every joint was completely filled. After the top had been slushed it formed the floor of the outlet. The opening is 5 feet wide and 5 feet extreme height, arched on top. The side walls are 2½ feet thick, the arch 16 inches thick, made of a lot of condemned sandstone curbstones, which, being more or less wedge-shaped, worked satisfactorily into an arch. The stones were used in their original lengths of 10, 12, and 14 feet. This outlet has never shown any signs of settlement nor given any trouble.

The gate is a Gordon Land railroad gate. It is operated by wire ropes which lead up the side of the embankment to a windlass on top. The gate is not wholly satisfactory. It is impossible to make it tight.

WINDSOR RESERVOIR.

This reservoir (Pl. LVIII, fig. 1) covers 700 acres, is 30 feet deep, and holds 13,774 acre-feet of water. The bottom of the basin is considerably below the bottom of the outlet. After drawing off all the water which can be run out, 150 acres of water surface remain. This furnishes a catchment for sediment. The reservoir cost $50,000, and is valued at $300,000.

This reservoir is owned by ex-Governor B. H. Eaton. None of the

water is used by its owner, but is exchanged for the water of reservoirs located higher up on the slope. The owner claims that without the opportunity to make this exchange it would be impossible to raise potatoes.

The top of the embankment is 34 feet above the outlet. This includes a cut of 17½ feet made for the outlet. The width on top is 20 feet; slopes about 2½ to 1; length about one-half mile. In building the embankment it was made in 1-foot layers, well trodden down. It is protected on the inside by brush weighted with stone.

The outlet is stone masonry. In its construction a cut of 17½ feet was made, the top being decomposed slate, while lower down was placed firm slate. The excavation was 8 feet wide. On the bottom was laid a foundation of concrete (cement, gravel, and sand) 1 foot thick, surfaced with 2 inches of neat cement, on which were placed flagstones 6 inches thick, forming the floor of the outlet. The outlet, which is arched over on top, is 4 feet wide and 5 feet high, with walls 2 feet thick. The construction of the outlet took 500 loads of gravel, 364 barrels of 400 pounds each of hydraulic cement, and 70 carloads of stone. The gate is of malleable cast iron, weighing 1,040 pounds, slides in an iron frame with flanges on the side next the water, and is raised by a screw. The gate stem is of oak, 8 by 10 inches.

The first year the reservoir was built a wooden gate was used, which swelled and gave so much trouble that it was taken out after one season's trial.

The reservoir is filled during the winter and early spring during the floods in the river. The water is brought to it by the Larimer and Weld Canal. It is taken out when needed for the potato crop in August and September. When water is run out of the reservoir for exchange purposes it is measured over a rated weir.

RESERVOIRS OF THE WATER SUPPLY AND STORAGE COMPANY.

This company owns the Larimer County Canal and reservoirs 1, 2, 3, 4, and 5 (or Long Pond) and Lindemeier Lake, which it operates as one system; it also owns Curtis Lake and Chambers Lake, two independent reservoirs.

RESERVOIR NO. 1.—Area, 226 acres; depth of water, 30 feet; capacity, 4,725 acre-feet. The outlet is tunneled under the company's canal, and consists of a stone tube laid in concrete and cement. The gates are of wood, faced with iron. This outlet was first operated in 1892 or 1893.

RESERVOIRS NOS. 2 AND 3.—These two reservoirs have been made into one by widening the ditch connecting them. Calling them one reservoir, the area is 128 acres; depth of water, 11.3 feet; capacity, 1,026 acre-feet. The outlet is of stone. The gate is of wood, faced with iron. These reservoirs cost $50,000.

RESERVOIR No. 4.—Area, 83 acres; depth of water, 19 feet; capacity, 996 acre-feet. The outlet is of stone, built in an open cut. Before refilling two concrete collars were built around the tube to prevent leakage. As the earth was filled in around the outlet pipe it was thoroughly puddled with water, the puddling process being continued to the top of the fill. (For details see Pl. LIX.) The gate is of wood, faced with iron.

RESERVOIR No. 5 (OR LONG POND).—Area, 230 acres; depth of water, 29.6 feet; capacity, 3,922 acre-feet. The outlet is a stone box, 3 feet wide and 4 feet high. The gate is of wood, faced with iron, and placed in a well 3 feet by 4 feet inside, the walls being 2 feet thick.

LINDEMEIER LAKE.—Area, 106 acres; depth of water, 8 feet; capacity, 717 acre-feet. The gate is of wood, faced with iron.

CURTIS LAKE.—Area, 113 acres; depth of water, 9 feet; capacity, 778 acre-feet. This has a stone outlet, the gate being of wood, faced with iron. This lake is not on the main system, and is operated independently. It is filled from the Larimer County Canal and exchanged into Dry Creek.

CHAMBERS LAKE.—This reservoir differs from all the others of the system, as it is in the channel of a stream. It is a natural lake at the headwaters of Cache la Poudre River, entirely separate from the other reservoirs of the company. Storage is effected by a wooden dam founded on piling. It was first operated in 1885. It was filled last fall and winter. Capacity, 1,259 acre-feet.

The lake is part of the natural stream, and the natural flow must at all times be maintained. For a good part of the year the whole flow coming into the lake goes over the spillway. The run-out takes place in the latter part of August, and continues only about ten days. The flow of the river at this point in December is about 20 cubic feet per second; in July about 1,000 cubic feet per second; and at the time of the run-off last fall, about 100 cubic feet per second. This flow does not belong to the Water Supply and Storage Company, and must be allowed to go by.

The cost of the reservoir was $6,052.56. A man is needed at flood time and at running-off time, but the expense of maintenance is not great.

Reservoirs Nos. 1, 2, 3, 4, and 5 and Lindemeier Lake are all used as one system. They are filled from the Cache la Poudre River by way of the Larimer County Canal.

The Larimer County Canal is one of the latest appropriators among the large ditches from Poudre River, and has no right for direct irrigation when the stream is low. The reservoirs are relied upon to maintain a constant flow in the canal, which is done in the following manner: When the river is high, the canal is filled to its full capacity,

and the excess is run into the reservoirs. When the river falls, these reservoirs are emptied into the ditches below, which have an early right. In return for this stored water the canal is permitted to divert an equal quantity directly from the stream. At the flood season the river rises and falls so quickly that the Larimer County Canal may fill its reservoirs in the forenoon and pay its water out in the afternoon of the same day. The water taken from the reservoirs in the early spring is used on wheat and alfalfa, and that taken in the fall is used on potatoes and a third crop of alfalfa.

The total expense of maintaining all the reservoirs of the company is not over $1,000 per annum.

All the laterals from Larimer County Canal are taken through bank by iron pipe, which is closed by the Powell head gate, a sloping gate, the gate stem extending to top of bank. The quantity of water used by each lateral is measured by a weir.

TYPICAL RESERVOIRS IN THE BIG THOMPSON VALLEY.

LAKE LOVELAND.

This reservoir (Pl. LVIII, fig. 2) is owned by the Loveland and Greeley Irrigation and Land Company. It holds 13,774 acre-feet of water, and cost $125,000. The site is a natural basin, and the cost of its improvement was mainly due to a dam and a tunnel three-fourths of a mile long. The dam is of earth, 400 feet long, with an extreme height of 18 feet. It is 20 feet wide on top, with inside slopes of 3 to 1 and outside slopes of 1½ to 1. It is well riprapped with stone, but was not built in layers and not puddled. When the reservoir is filled there is 15 feet of water against the dam. It is filled from Big Thompson River through the Barnes Ditch, which is 3½ miles long. The outlet tunnel is 5 feet in diameter, made of hard brick, laid in Portland cement. The tower from which the gates are operated is at the upper end of the outlet tunnel, is 40 feet high, and is built of hard brick. The first gates were inside gates of oak, 3 inches thick, with iron straps bolted on, but these leaked after being used for two years; the outside gates were of cast iron, half an inch thick, with a rim 1 inch wide, and 1 inch thick where the gates worked in brass grooves. These gates were backed with oak 2 inches thick, bolted to the iron. They have since been replaced by cast-iron gates with wrought-iron ribs.

The reservoir has been operated five years. It was filled to its full depth (40 feet) in 1900 and to a depth of 37 feet in 1901. The reservoir rights sell at $750 each, and there are 300 rights. The annual assessment on each share for maintenance is $10. The company has sold 175 rights out of the 300 to farmers who use the water. The necessity for late water, due to the raising of sugar beets and other vegetables, may raise the price of the shares to $1,000. The first run was

commenced July 1, and there was a period of ten days between each of the five runs. The canal will satisfy the demand until July 1, but it is impossible to raise vegetables without the use of the reservoir. Twenty thousand acres are irrigated under this system. Water is measured in flumes, which are rated. The reservoir alone will irrigate about 8,000 acres.

When a majority of the users call for water it is turned out of the reservoir and all have to use it at that time. The users designate the number of cubic feet per second to be turned out, and it is divided in proportion to the shares, in accordance with the contract made when the reservoir right is purchased.

Lake Loveland is the third largest reservoir in Colorado, it being surpassed only by the Twin Lakes and Great Plains system. The Windsor Reservoir on the Cache la Poudre is the fourth largest.

LITTLE THOMPSON RESERVOIR.

This reservoir is owned by the Little Thompson Reservoir and Water Supply Company. The capacity is 987 acre-feet; cost, $18,000; present value, $24,000. The dam, which was constructed in layers 3 feet thick and was not riprapped, is 860 feet long, with a width on bottom of 280 feet and on top of 10 feet; outside slope, 1½ to 1, and inside slope, 5 to 1.

The outlet consists of two cement pipes 240 feet long, 21 inches in diameter, with cement concrete collars at each joint. The pipes are laid in a concrete bed 6 inches thick and 6 feet wide. Retaining walls and wings 6 feet high, of vitrified brick, are constructed at each end of the outlet pipes, and the lower apron is set 4 feet in the solid earth. The length of the cut from the end of the outlet pipes into the basin is 37 feet. The gates are of wood, slide in steel bearings, and are operated from a vitrified brick tower 34 feet high, set in the middle of the dam, and resting on a 2-foot cement foundation. The gate rods, 1½ inches in diameter, are 34 feet long, and it has been found necessary to brace them every 2 feet to prevent springing. The Hillsborough Canal ran through the reservoir site, and a dam 15 feet high was built on the top of the old embankment of the ditch where it made a curve to cross a draw. No care was used to make a good joint between the old embankment and the new, and, the loose dirt becoming moist from seepage, in June, 1900, the dam gave way to within 2 inches of the water's edge. There was at the time 29 feet of water against the dam. In repairing this break rock and gravel were used to make a solid foundation.

The reservoir is filled from Little Thompson Creek and from waste and surplus water of the Hillsborough Canal, which takes its water from the Big Thompson. The inlet from Little Thompson Creek is

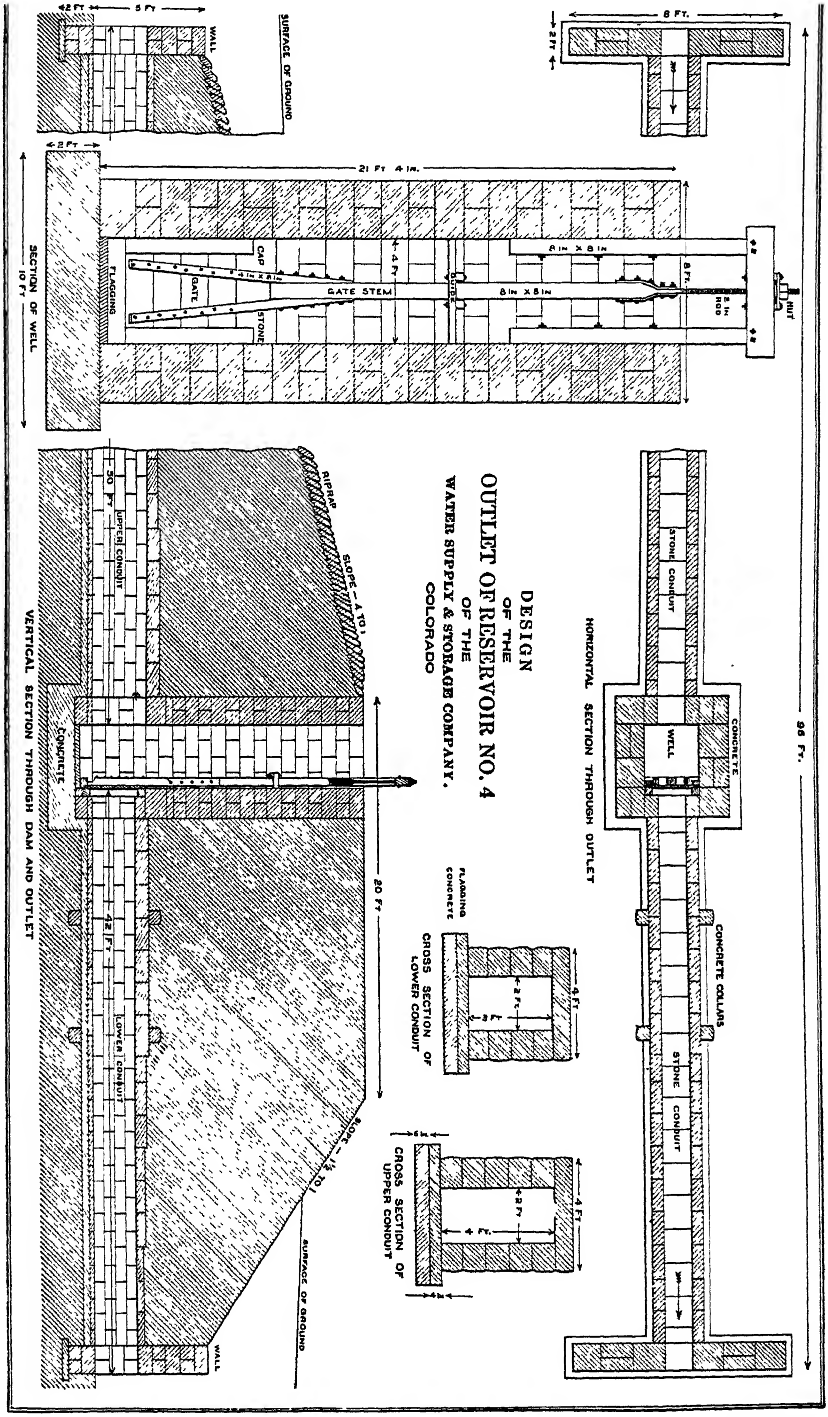
the Little Thompson Ditch, which is in part the continuation of the Hillsborough Canal from the point where it crosses Little Thompson. It has a capacity of 150 cubic feet per second. The water coming to the reservoir will fill it at least four times each year, and is used by the farmers who constructed this system. The stock consists of 120 shares; par value, $90 per share; present value, $200 per share.

Prior to 1897 every farm, without exception, under the Hillsborough Canal below the reservoir that had been dependent upon the canal alone went to foreclosure, and could not be made to produce the owner's expense of maintenance. The best land, with water rights, could be bought for from $12 to $15 per acre in 1898. As the result of the construction of the reservoir, the same land is now selling at $80 per acre. The Little Thompson delivers to the inlet ditch during April about 40 cubic feet per second; in June, July, and August, from 10 to 15 cubic feet per second. During July, August, and September the stream has been made up from seepage and waste waters. It gains in seepage about 1 cubic foot per second per mile. Fifteen years ago the creek was dry during these months. The canal below the reservoir irrigated about 2,000 acres this year. The cost of superintendence and maintenance of the reservoir is $600 per annum. The water is measured by trapezoidal weirs.

The Little Thompson Reservoir is only 3½ miles from the lower end of the Hillsborough Canal, and the irrigators below the reservoir can not depend wholly upon the reservoir water during the season. This being the only reservoir under the Hillsborough Canal, its water supply is not so good above the reservoir. The Hillsborough Canal has, however, consolidated with another ditch having an early priority. A suit is pending contesting the right of the canal company to change the place of diversion and of taking the water. In 1901 the average yield of potatoes under this reservoir was 250 bushels per acre. One field averaged 408 bushels per acre, and another 360 bushels per acre.

IRRIGATION IN THE POUDRE VALLEY IN 1901.

For one day in May the Poudre River carried 5,000 cubic feet per second, and for nearly three weeks a large volume of water ran to waste. With all the ditches running to their full capacity the river remained filled to the top of its banks. By July 1 all this was changed. The drop in the river's flow was startling in its suddenness. On the 3d of July the stream carried 1,274 cubic feet per second. Six days later it carried less than half of this, or 631 cubic feet per second. On the last day of July the discharge was 332 cubic feet per second. The stream had ceased to be a river and become a creek. There is one ditch from this river that carries 720 cubic feet per second, which is more than the average discharge for July. The mean flow for July



DETAILS OF CONSTRUCTION OF RESERVOIR DAM AND OUTLET.

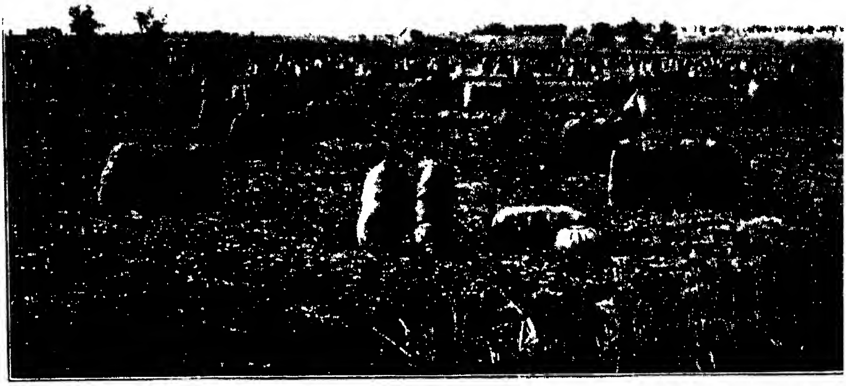


FIG. 1.—HARVESTING ONIONS, GREELEY, COLO.

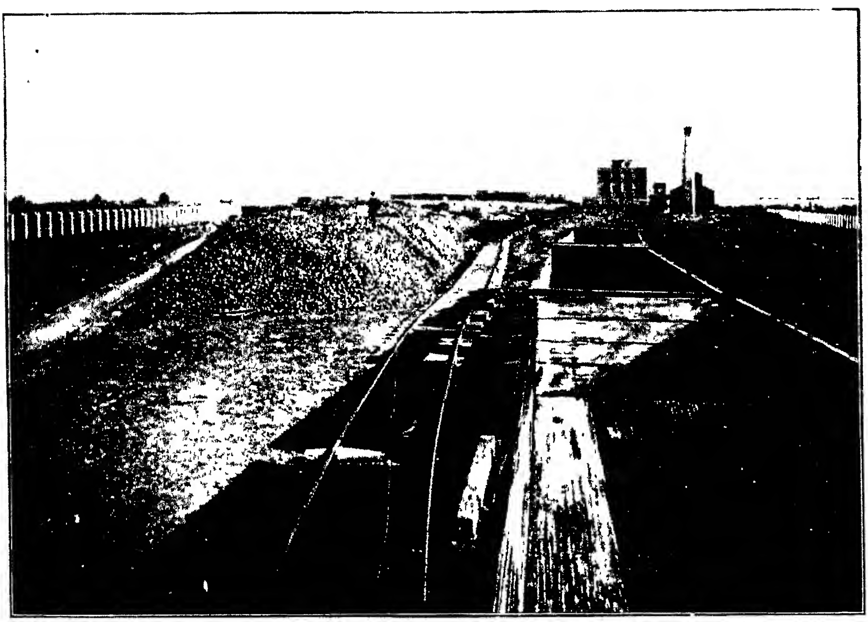


FIG. 2.—SUGAR BEETS AT LOVELAND FACTORY, COLO.

was 682 cubic feet per second, for August 282 cubic feet per second, and for September 159 cubic feet per second. The entire flow of the river for August and September was 26,800 acre feet, which was less than half the volume stored in the reservoirs. During these two critical months of the irrigation period more water was taken from reservoirs than from the river. Nearly all of the valuable crops would have been lost without the reservoirs.

Complete statistics of the total production of the valley could not be secured, as many farmers had not yet marketed their products when this paper was prepared, but from estimates made by produce dealers and farmers, it is believed that the average yield of potatoes for 1901 was between 80 and 85 sacks per acre, which are being sold at about $1.25 a sack. The average yield of cabbage was 20,000 pounds per acre, and onions 200 sacks per acre. It is estimated that 500 cars of cabbage and onions and 6,500 cars of potatoes are annually shipped from Greeley. Five acres of onions near Greeley produced this year 1,920 sacks, which sold for $1.15 per 100 pounds. Another 5 acres produced 1,500 sacks, which sold for $2 per 100 pounds, or about $600 an acre. (See Pls. LX and LXI.)

From the Larimer and Weld Reservoir 3,720 acres of land was irrigated this year. The yield of potatoes was 95 sacks per acre. From the Cache la Poudre Reservoir 6,500 acres of potatoes were irrigated. The average yield was 85 sacks per acre. A reservoir right this season irrigated on an average 10 acres of potatoes, and the use of one of these rights for this year rented for $90. If all the 375 rights had been rented at this rate, the total income from the reservoir would have been $33,750. Deducting $1,000 for operation, there remains $32,750 as a net income from a $105,000 investment, or 31 per cent, which is not a bad return. It is estimated that 6,250 acres of potatoes and 150 acres of sugar beets were irrigated from Windsor Reservoir, a single right irrigating 25 acres.

One of the most important uses of stored water is in the irrigation of orchards, of which the valley has about 1,500 acres. For this purpose water was used as late as November 24, 1900, and as early as March 2, 1901. These orchards are irrigated frequently after September 1, until it is difficult to carry water in the ditches and laterals. Before stored water was available for orchard irrigation many of the trees under ditches having inferior appropriations died each year. Now they survive with little loss.

From reservoirs of the Water Supply Storage Company 5,500 acres of potatoes were irrigated. The average yield was 90 sacks per acre. A single share in these reservoirs irrigated 11 acres of potatoes. Stored water was also used to irrigate the third crop of alfalfa.

The best estimates give the total cost of the reservoirs of the Poudre Valley as $450,000, and the worth to the valley as $1,000,000 each year.

CROP REPORTS OF THE BIG THOMPSON VALLEY FOR 1901.

The State engineer of Colorado estimates that to bring the crops of Big Thompson Valley to maturity there should be an average water supply of 400 cubic feet per second in August and September. In 1901 the river fell far short of this, the mean discharge for August being 269 cubic feet per second, and for September 72.5 cubic feet per second, or a deficiency of over 100 cubic feet per second for August and over 300 cubic feet per second for September. Without the reservoirs, therefore, many farmers would have suffered. The flow of the stream for these two months was 27,543 acre-feet below the State engineer's estimate of what was necessary. But the reservoirs, of which the capacity was ascertained, hold 45,000 acre-feet, and as these were all filled, they much more than replaced the shortage. The farmers under them had an ample water supply, and were in a position to secure satisfactory results. From the crop reports obtained for 1901 the following statements have been abstracted:

Under Lake Loveland and Seven Lakes reservoirs 2,100 acres of potatoes were grown, with an average yield of 80 sacks per acre; total number of sacks, 168,000; estimated value, $210,000.

Six acres of potatoes under the Loveland and Greeley Canal sold for $1,380.

Forty acres of potatoes watered from Lake Loveland and Seven Lakes yielded 4,530 sacks, 100 pounds to the sack. One hundred and sixty acres of potatoes irrigated from these reservoirs yielded 100 sacks per acre, a cash return at current prices of $125 an acre.

Ninety-six acres of potatoes were grown under the Little Thompson Reservoir. The yield was 135 sacks per acre. Wheat averaged 30 bushels per acre and alfalfa 4 tons per acre. All the crops used water from the reservoir. There never was a paying crop until the reservoir was constructed.

Without reservoirs the growing of sugar beets in this valley would not be profitable. Eight hundred acres of sugar beets yielded over 15 tons per acre. The profit to the farmers growing them was over $40 per acre.

Five hundred acres of sugar beets irrigated from the Lone Tree and Mariano reservoirs yielded over 15 tons per acre.

This year the Great Western Sugar Company, owner of the factory at Loveland (see Pl. LX, fig. 2) bought 66,000 tons of beets, for which it paid $4.50 per ton. The average yield of the district was 13½ tons per acre, with an average of 15 per cent sugar and 85 per cent purity. Twelve hundred acres of beets were grown in the Cache la Poudre Valley, and 2,300 in the Big Thompson Valley. The average profit of farmers is estimated at $37 per acre. The yields would have been much greater had the farmers had more faith in the industry. In

many cases the beets were planted on the poorest ground, the best land being used for potatoes. Next year many more acres will be planted, and the cultivation will be better.

The following table gives data for reservoirs now being operated in the Poudre and Big Thompson valleys, not heretofore described:

Data of reservoirs now being operated in Poudre and Big Thompson valleys.

POUDRE VALLEY.

Name of reservoir.	Acres covered.	Depth of water.	Capacity.
North Poudre system:		*Feet.*	*Cubic feet.*
No. 1	80	20	29,350,000
No. 2	240	25	145,350,000
No. 3	160	25	111,060,000
No. 4	80	10	47,005,000
No. 5	425	25	229,000,000
No. 6	650	30	500,000,000
Tom Wood	120	8	
Ralph	96.5	10	17,500,000
Forfar	66	8	21,000,000
Antelope	63.6	15	30,490,000
Douglas, or North Poudre No. 10	470	35	[a]450,000,000
North Poudre No. 8	500	44	[a]425,000,000
Fossil Creek	705	35	[a]490,000,000
Richards	100	31	[a]45,000,000
Elder Lake	54	18	25,100,000
James Lake	73	18	34,900,000
Bennett	20	10	5,780,000
Ault	25	8	[b]5,830,000

BIG THOMPSON VALLEY.

Name of reservoir.	Acres covered.	Depth of water.	Capacity.
Lone Tree	600	16½	392,040,000
Mariano		16½	180,338,400
Seven Lakes reservoirs	676		252,000,000
Ish Lake	40		16,000,000
Beasley	155	19	50,000,000
Hummell	35	10	12,807,000
Welch reservoirs, Nos. 1, 2, and 3	270		167,000,000
De France	20	15	13,068,000
Wilson	10	8	6,511,000
Wilson-Strever	31	6	
Town Lake	40		
Hupp Lake	15		2,200,000
Welch Lake	23	10	2,900,000
Big Cut	75		50,000,000
Benson	13	4	
Rist	27		500,000
White-Bulter		25	8,000,000
Fairport Lake	60	12	
Steele	9		1,600,000

[a] Will be completed for use in 1902.

[b] Three projected reservoirs, largest one to hold 22,956 acre-feet.

In addition to the above there are the following reservoirs, of which the dimensions could not be obtained: Kee, Huppe, Fagan, Smith Weldy, Shay, Cole, Jansen, Bartell, Bental, Culver, Sheep Draw, Berthoff, Smith.

RESERVOIRS IN UTAH.

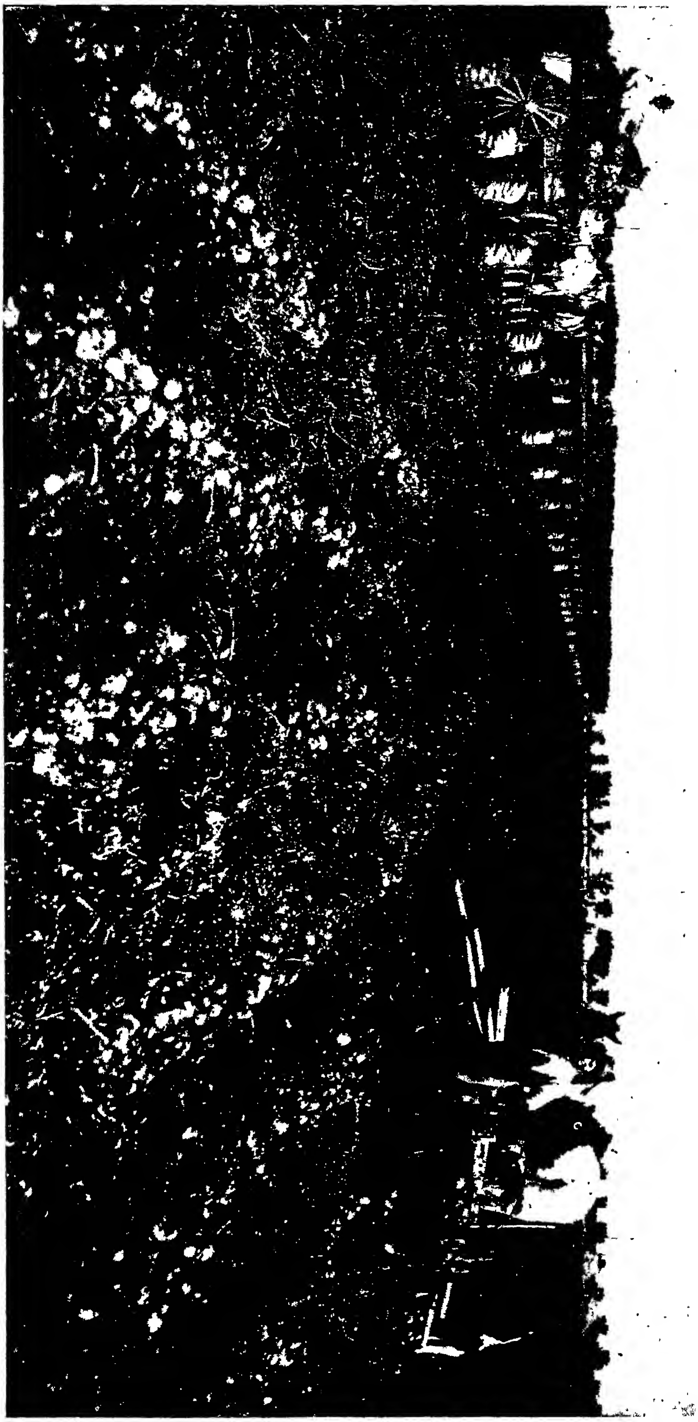
EAST CANYON CREEK RESERVOIR.

The reservoir on Canyon Creek (see Pl. LXII), a tributary of the Weber River, illustrates the results of water storage in Utah. It was built by the farmers under the Davis and Weber Counties Canal to reinforce their water supply for the latter part of the irrigation season. Weber River irrigates part of Salt Lake Valley surrounding the city of Ogden. The soil and climate of this section are well suited to market gardening and fruit growing, and these have become important industries. Ten canning factories and a beet-sugar factory have been erected here, and large quantities of vegetables and fruits are shipped to the surrounding country during the growing season. As the growing of high-priced products extended it was found that the water supply of the river could not be relied upon. There is a flood in May and June, but the river shrinks rapidly after this. Only the earlier appropriators can rely upon an ample water supply after the 1st of July.

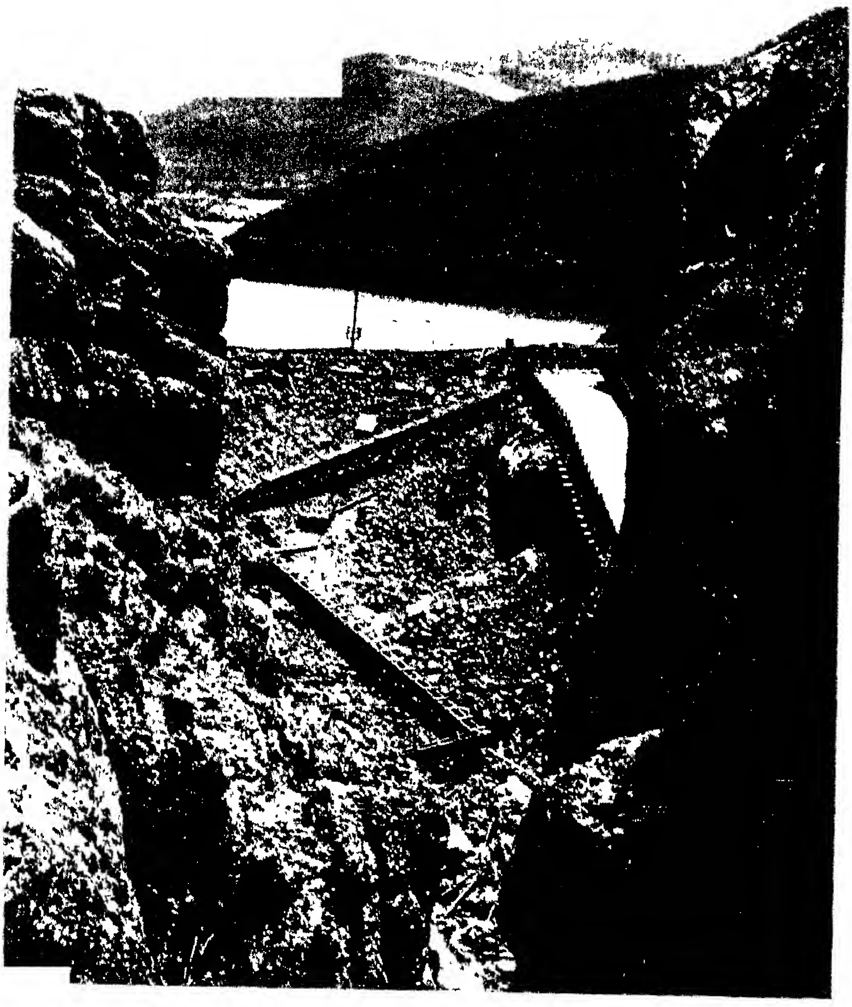
The farmers under the Davis and Weber Counties Canal have a late appropriation, and when the river drops, as it did in 1899, from 4,588 cubic feet per second in June to 445 cubic feet per second in July, nothing remains for such appropriators. This shrinkage to one-tenth of its earlier discharge in thirty days is not unusual, and for several years irrigators under the Davis and Weber Counties Canal have had to suffer not only in actual loss of crops, but in anxiety over the dangers of these losses. Three years ago they united in the construction of a reservoir on Canyon Creek, about 30 miles above the head of their ditch. It consists of a loose rock dam, faced on the front with steel plates, is 93 feet high, and holds 8,919 acre-feet of water. In 1901 the gates were closed and the reservoir began filling on March 27. On May 14 it was filled to its full capacity. The gates were opened and the irrigators began using the stored water on July 2. The reservoir was emptied September 1.

This reservoir cost $85,000; 8 per cent interest on this would be $6,800, and adding to this the expense of operation, $500, gives $7,300 as the sum which the reservoir should return to farmers to make the investment a profitable one.

The officers of the company estimate that in 1901 the reservoir paid its owners $50,000, or more than half its cost, after deducting the interest charges and operating expenses. But this financial return does not measure the benefits of the reservoir. It has lifted a load of



POTATO FIELD NEAR GREELEY, COLO.



WASTEWAY, EAST CANYON CREEK RESERVOIR, UTAH.

anxiety and dread from the irrigators who own it, and who now know that when they plant a crop they will have water to bring it to maturity. They could not be sure of this when they relied entirely upon the stream. Its completion is changing the appearance of farmers' homes. They can now plant orchards and set out shade and ornamental trees. Before the reservoir was built little attention was paid to tree culture or to beautifying their surroundings, because of the danger of trees dying from drought.

The secretary of the company says that the average yield of tomatoes and beets has been increased by the reservoir 50 per cent, and the average increase in hay and grain 25 to 40 per cent. The engineer of the company makes the following estimate of the increase in the productive capacity of the land in 1901:

Increase in productive capacity of land due to use of reservoir water.

	Per cent.
Alfalfa	50
Tomatoes	60
Sugar beets	60
Small fruits and other vegetables	60

From the canning factories comes the statement that the reservoir has greatly benefited this industry. Before the construction of the reservoir farmers were afraid to enter into contracts to supply the factories, and the factories were always in dread of a crop failure. These factories estimate the increased yield of the products they handle at from 50 to 75 per cent.

The large profits which have come from the building of these reservoirs and many others of which a record has been obtained does not show, however, that reservoir building can be safely or wisely left wholly to private enterprise.

In the first place, the profits of these reservoirs are due to the fact that they furnish a supplemental water supply to old and well-established communities. They probably would not be profitable if the water had to be used wholly on unimproved land.

In the second place, there is a class of reservoirs which ought never to be private works, no matter whether they will or will not be profitable as private investments. These are reservoirs located in the channels of running streams, remote from the place where the water is to be used. Such storage works so vitally affect the interests of the appropriators of the natural streams as to always threaten conflicts or controversies over the division of the public water of the stream and the private water of the reservoir. Many of these reservoirs would doubtless be enormously profitable if built by private capital, because they would control production on the land irrigated; but this profit, instead of an argument in favor of private construction, is the most serious objection against it. The user of the water should not be

oppressively taxed to obtain it. Toll bridges across the streams on many highways have paid, but public convenience and public welfare has made all, except a few, of these structures free. The same causes ought to make certain reservoirs public.

GENERAL CONCLUSIONS.

From the facts before stated and others gathered in these investigations, the following conclusions have been reached:

(1) That reservoirs are needed to supplement and regulate the flow of streams.

(2) That the existence of reservoirs makes possible the raising of trees and the maturing of higher-priced products.

(3) That the construction of reservoirs by private capital has been very profitable to their builders and of great benefit to farmers.

(4) That the construction of reservoirs by private capital is destined to assume large proportions.

(5) That Government aid in the construction of these works is only needed in projects of exceptional magnitude and cost, or where their location renders it desirable that they should be maintained and operated perpetually as public works.

THE HOME FRUIT GARDEN.

By L. C. Corbett,
Horticulturist, Bureau of Plant Industry.

INTRODUCTION.

A fruit garden consists of an assemblage of fruit-bearing trees and shrubs, maintained for the purpose of supplying the family with fruits. In its general purposes, then, the fruit garden is intended to accomplish results similar to those of the vegetable garden. In distinction from an orchard, the fruit garden is more restricted in area, is intended for home rather than market purposes, and consequently comprises a much greater variety of fruits.

Considering the general desire for and appreciation of fruits by people of all classes, it is amazing that even those who have suitable situations and facilities for raising them, and who can not purchase them because of remoteness from markets, have not established home fruit gardens.

With the growth of the commercial fruit interests of the United States, the home fruit garden has been lost sight of. Only a few years ago the owners of home gardens not only led in the production of fruits, but were our authorities as to how and where to grow them. To-day these gardens, while no less numerous or important, are overshadowed by the orchards where fruit is grown for commercial purposes.

RELATION OF THE HOME GARDEN TO THE FRUIT INTERESTS.

While both the home garden and the orchard are essential to the good of the community, they bear very different relations to the fruit interests of the country as a whole. Home gardens are usually considered quite as much a source of pleasure as of profit. Persons who maintain them do so in order to insure a supply of choice fruits to meet the demands of their own tables, and the idea is high quality rather than large quantity or profit. With them fruit growing becomes a pleasure and a pastime. The home garden is always the forerunner of commercial development, and even in those localities where climatic and soil conditions are adverse to such industries in a commercial way the home fruit garden of the enthusiastic amateur is certain to be found. All the success attained to-day by the fruit interests of the United

States has grown out of the persevering efforts of a few men whose names stand high in the horticultural history of the country. The home fruit gardens of these men served not only as testing stations for determining the fitness of given sorts for new and untried localities, but they were the propagating grounds from which sorts of the highest quality and greatest commercial value originated. The germ of the present commercial grape industry of the Eastern United States developed in the fruit garden of John Adlum. The American raspberry industry dates from the day when Nicholas Longworth transplanted the wild "Blackcap" to his Cincinnati garden. Practically, all of the better hybrid grapes which are now cultivated in the Eastern United States sprung from the home fruit gardens of Rogers and Rickets, and form enduring monuments to their love for and interest in horticulture. Among modern workers the name of none stands out more markedly than that of Luther Burbank, of California, whose garden has, during the last decade, amplified the fruit list, as well as contributed valuable additions to the hardy ornamentals.

INFLUENCE OF AMATEUR FRUIT GROWERS UPON COMMUNITIES.

The testing of varieties in new localities and the development and dissemination of new sorts by the amateur is an important work, but the greatest good accomplished by him is to be found in the wholesome influence which he exerts on the community in which he lives. A community is certain to profit æsthetically as well as financially from the influence of such growers, and it is to them that we owe our appreciation for high quality. A discriminating taste developed in a neighborhood creates a demand which it pays well to gratify, and the amateur who grows fruits for quality will find a ready market in such a section.

Nearly every fruit-producing region of commercial importance owes its development to the influence of some one individual. In West Virginia, for instance, there are two well-marked commercial fruit developments, each of which is easily traced to the work of one man, who started out with the idea of growing fruit for the home supply. Each of these districts has developed into an important commercial fruit region.

The famous grape region which borders the interior lakes of central and western New York had its inception in small plantations, the earliest of which there is any record at hand being that of Rev. William Bostwick, put out in the early forties. From this fruit garden as a nucleus, the whole grape area of the region has developed.

The immense viticultural and citrus industries, which are marked characteristics of the horticulture of the Pacific Slope have grown out of the early plantings made by the Catholic missionaries, who carried with them trees and vines and spread a desire for fruit. It is safe to

say that such illustrations would be afforded by every important fruit-growing region of the country. While this phase of the fruit garden's influence is important and more apparent than any other, it is certainly no more important or far-reaching than its influence upon the variety list, even of the commercial growers. The watchful care and perseverance of amateur fruit growers and plant breeders have transformed our fruit list from one composed at first almost exclusively of European varieties into a list which is to-day almost completely composed of American sorts. Most of the American-bred varieties have, it is true, a more or less remote European or Oriental parentage, but early experience taught the fallacy of attempting to disseminate foreign sorts without amelioration, as home-grown seedlings from the original importations often proved themselves much superior to the originals in their ability to withstand the changed conditions of soil and climate.

CHANGED CONDITIONS OF FRUIT CULTURE.

Until within comparatively recent times, the introduction of foreign species worthy of cultivation in this country was largely confined to horticulturists, who maintained private fruit gardens or nurseries. In fact, previous to the establishment of the State experiment stations by Congress in 1887, an important function of the work of the nurseryman was the introduction and testing of new sorts, both of foreign and domestic origin. While the commercial dissemination and popularization of fruits is at present almost exclusively in the hands of the nurseryman, the introduction of foreign species and varieties, as well as the testing of both foreign and domestic sorts, has fallen largely into the hands of the Department of Agriculture and the experiment stations. The general perspective of fruit culture in America has been greatly changed during the last twenty-five years, and many of the lines of work carried on in private fruit gardens have been absorbed wholly or in part by other forces; yet the profitable occupation of fruit growing is ever open to the amateur, to say nothing of the highly interesting work of plant breeding.

ADVANTAGES AND PLEASURES OF THE HOME FRUIT GARDEN.

The people of this country are notably a fruit-loving and fruit-eating people. Notwithstanding this, however, fruit culture has grown to be classed among the specialties, and few persons who consume fruit are actual growers. The possibilities in fruit culture upon restricted areas have been very generally overlooked, with the result that many persons who own a city lot, a suburban home, or even a farm, now look upon fruit as a luxury. This can all be changed, and much of the land which is now practically waste and entirely unremunerative can be made to produce fruits in sufficient quantity to give them a regular place upon the family bill of fare and at the same time add greatly to

the attractiveness of the table and healthfulness of the diet. The home production of fruit stimulates an interest in, and a love for, natural objects, which can only be acquired by that familiarity with them which comes through their culture. The cultivation of fruits teaches discrimination. A grower is a much more intelligent buyer than one who has not had the advantages of tasting the better dessert sorts as they come from the tree. If every purchaser was a good judge of the different kinds of fruits the demand for fruits of high quality, which is the ambition of every amateur as well as of every professional fruit grower, would become a reality. But until some means of teaching the differences in the quality of fruits can be devised the general public will continue to buy according to the eye rather than by the palate. The encouragement of the cultivation of fine fruits in the home garden will do much toward teaching buyers this discrimination.

Besides increasing the fruit supply and cultivating a taste for quality, the maintenance of a fruit garden brings pleasant and healthful employment, and as one's interest in growing plants increases this employment, instead of proving a hardship, will become a great source of pleasure. The possession of a tree, which one himself has planted and reared to fruit production, carries an added interest in its product, as well as in the operation by which it was secured. The unfolding of the leaf, the exposure of the blossom buds, the development of the flowers, and the formation of the fruit are all processes which measure the skill of the cultivator, and when the crowning result of all these natural functions has been attained in a crop of perfect fruit, the man under whose care these results have been achieved will himself have been made happier and better.

To those familiar with the facilities at command for the culture of fruit and the general interest in the subject, the remarkable absence of successful fruit gardens about city, suburban, and country residences can only be explained on the ground that those who would be most likely to give attention to their care and maintenance have no object lessons or literature at hand to guide them in laying out such gardens.

THE CULTIVATION OF A HOME FRUIT GARDEN.

Most persons engaging in the cultivation of a home fruit garden will have as their chief aim the production of fruit for the family table and the pleasure it affords; others will go a step further and find an added source of pleasure in the problems of cross pollination and the production of new forms. In a majority of cases, however, the aim will be the one first mentioned, and it is to assist such that the suggestions contained in this paper are offered. In order to prove a source of constant pleasure and gratification a fruit plantation must

claim the attention of its owner from early spring to late autumn, its products, too, must be so planned as to cover the greatest possible portion of the seasons between frosts. The problem presented involves a succession of fruits, from earliest to latest, as well as a combination of light-loving and shade-enduring plants. The intensive culture and the liberal feeding to be given demand that all plants be of types which bear early and heavily in proportion to their size. The question of longevity is of no moment; immediate fruit production is the object. With this view of the question, taken in connection with the great variety of conditions presented both by the extent of the country and the manner of life of those interested, it is manifestly impossible to make general statements.

As the individual taste of the owner will greatly modify the character of any particular garden, a general scheme must be taken as a basis for the work, and this, of course, need not be modified for the section in which it is used, except in so far as the varying habits of the plants to be grown demand. To illustrate: The arrangement of fruit borders and walks may be the same for gardens of like dimensions all over the United States, but the varieties to be grown in these borders must be modified to suit the conditions of climate in which the garden is placed. The fruits best suited to the various sections of the United States[1] can not be enumerated here, and this paper will be confined to a brief discussion of the methods of propagation, planting, pruning, and general culture.

SOIL.

Since one does not choose the site of his residence on account of the character of the soil of the locality, but because of other natural advantages of the place, it is obvious that the soil at the disposal of the grower will frequently be ill-suited to the purposes of a home fruit garden. For a commercial place on an extensive scale it would be out of the question to attempt to alter the character of the soil to suit the needs of the plant, but with a small area the case is quite different. If the soil is heavy, it can be lightened with sand if it is not desirable to increase the proportion of humus which it contains; if it is lacking in organic matter, the addition of leaf mold and well-rotted manure or the turning under of some leguminous crop, such as cowpeas or Canada field peas, will accomplish the desired result; if the soil is loose and sandy, losing its store of plant food readily, this fault can be remedied by the addition of retentive material, such as clay; the amount of clay to be added must be governed by the degree of

[1] Bul. No. 8, Division of Pomology, U. S. Dept. Agr., "Catalogue of fruits recommended for cultivation in the various sections of the United States," etc., gives nineteen pomological districts, with the various classes of fruits which can be grown in each.

stiffness desired in the soil. If, on the other hand, the class of plants to be generally grown is suited to a loose, sandy soil, and it seems desirable to add to the collection a plant, such as plum, which naturally requires a heavy, retentive soil, it would undoubtedly be better to change the character of the plant by grafting it upon a stock adapted to sandy soil conditions, rather than to attempt to modify the soil to suit the plant. This change can be effected by using a peach stock for the plum. We have, therefore, two alternatives—either the soil may be modified to suit the plant or the plant may be adapted, by working it upon a suitable stock, to the soil. Such modifications in plants are not always easily accomplished, and with many plants there is no alternative but to use them on their own roots. In this latter case the soil itself must be made to conform to the demands of the plants. The soil, in addition to being heavy and retentive, may also be cold and wet. In such case the addition of sand will not entirely overcome the difficulty. Sand will lighten and facilitate natural drainage, but if the soil be unduly moist the only safe and satisfactory remedy lies in thorough underdrainage. This can be accomplished in two ways: Drains may be dug and a stone conduit built to allow the superfluous water to escape, or, what is better, agricultural tile may be laid in the bottom of the trench. If the soil is very stiff and retentive, the tiles should not be laid over 2½ or 3 feet deep and about 1 rod apart. If the soil is porous, the drains may be placed farther apart and buried deeper. A double purpose is served by underdraining. The superfluous water which tended to make the land cold, sour, and "late" is removed, thus making the soil warmer and earlier; and by the admission of air the acidity is slowly overcome. The processes of oxidation and nitrification are also afforded better conditions for action, and while drainage adds nothing to the soil in the way of plant food, the mechanical operation of removing water and admitting air is quite as marked in its effects as a liberal dressing of manure, for the store of plant food which was withheld from the plant is allowed to become available. There is little wonder in the light of these facts that early agricultural writers propounded the axiom "tillage is manure."

PLANTING.

It is impossible to give explicit directions for the many plants which may be selected for planting in fruit gardens in the various sections of the United States, and general statements only can be made. At planting time all broken or decayed roots should be cut away, leaving only smooth-cut surfaces and healthy wood to come in contact with the soil. If a large part of the root area of the plant has been lost in transplanting, the top should be cut back in proportion to the roots remaining. By so doing the demand made by the top when the plant starts into growth can be met by the root.

The holes in which trees, vines, or shrubs are to be set should be ample, so that the roots of the plant may have full spread without bending them out of their natural course. The earth at the bottom of the holes should be loosened a spade depth below the line of excavation. The soil placed immediately in contact with the roots of the newly set plant should be rich top soil, free from sod or partially decayed organic matter. Firm the soil over the roots by trampling, as this brings the soil particles close together and at the same time in close contact with the surface of the roots. A movement of soil water is thus set up and the food supply of the soil brought immediately to the use of the plant. When the operation of transplanting is complete, the plant should stand 1 or 2 inches deeper than it stood in the nursery. Every precaution above enumerated will make for the success of the plant and calls for careful attention.

PRUNING.

While pruning has to be modified to suit the style of training employed with any given plant, each species of plant bears its fruit in a peculiar manner, which renders the maintenance of wood of a certain age and character necessary in order to secure a crop of fruit.

In the case of the apple and pear the fruits are borne upon wood of last year's growth only. Heading in or shortening each shoot of the season's growth, therefore, must be done with care in order not to reduce the bearing wood beyond a profitable limit. With these two plants, however, the bearing shoots are not those making the most vigorous growth at the ends of the branches, but they are usually more obscurely located upon the sides of the branches, and make a much smaller growth, for which reason they have been termed "spurs."

With the peach, however, it is the wood of the last season's growth upon which the fruits are directly borne, and with them heading in may be successfully employed to limit the quantity of fruit borne by the tree. Japan plums bear on both year-old wood and spurs; pruning may, therefore, be used to thin the fruit, the same as in the case of the peach.

The quince bears its fruit at the extremity of new shoots of the present season's growth, in which respect it differs from both its close relatives, the apple and the pear; but as these shoots arise from wood of the previous season's growth, pruning must be so adjusted that the fruit crop will not be reduced.

The grape bears its fruit on shoots of the season, which in turn usually arise from canes of the previous year's growth. Old wood on the grape is therefore of little value, hence the development of so many systems of training which maintain only a single permanent trunk, from the top of which the bearing canes are renewed each year. The so-called "renewal," "high renewal," "Kniffen," "Munson,"

and various overhead systems of training all possess this feature in common. In fact, it is the only economical way in which to handle native sorts. For the fruit garden, however, where the vines are desired for covering arbors, pruning must be modified so as to secure a screen from the new growth as early in the season as practicable. For this purpose a modification of the "horizontal-arm" system of training will be found most advantageous. By planting the vines closely and carrying up single trunks to a fixed height, and from the top of the stalk carrying out horizontal arms along which "spurs" are maintained, a short growth from each spur will be sufficient to give a uniform and sufficiently dense canopy of leaves for the arbor.

Raspberries and blackberries both bear their fruits on short shoots which arise from canes of the previous season's growth. While these shoots are usually axillary shoots, the fruits are always terminal. In the case of the grape, which bears its fruit upon annual shoots arising from canes of the previous year, the fruit is produced at a node, and takes the place of a leaf; several fruit clusters may therefore arise from a single shoot of the grape.

In the case of the currant and gooseberry the fruits are produced on both old and new wood; the fruits appear as axillary growths from the shoot itself, and wood 3 years or more of age is unprofitable and should be cut away.

Strawberries are rarely produced in profitable quantities by plants more than 1 year old. Plants over 2 years of age should be rooted out to give room for new ones.

The orange bears its fruit in much the same way as does the peach. New growth must therefore be maintained to insure a supply of fruit. But as the orange is evergreen, pruning can not be confined to a single season, as in the case of deciduous trees possessing a regular and marked period of rest.

PROTECTION.

The interest of a fruit garden may be greatly enhanced by growing therein plants not adapted naturally to the climatic region in which the garden is located, as, for instance, the growing of figs as far north as the latitude of Philadelphia. The summers of the region are sufficiently long and warm to induce a strong growth in the fig, but as the fruits normally require a long period in which to mature, the plant becomes useless as a fruit producer unless sufficient protection is afforded to carry over winter the immature fruits set the previous fall. This can be successfully accomplished in several ways. The most hardy sorts should be selected, in addition to which the fruiting shoots may be wrapped in matting, covered with straw, and the fruits thus successfully protected; or, if it seems desirable, temporary sheds may be built over the plants, and these thatched with straw or fodder

sufficiently to protect them from frost. Then, again, semihardy sorts may be tipped over by cutting the roots on one side, bending the branches close to the soil, pinning them down, and then covering the whole plant with matting and earth or a straw thatch and earth. At the extreme northern limit of fig culture it has been found that the covering of earth is preferable to any other method, while at the South, where only slight protection is necessary, bending down and covering with pine boughs or thatching with corn stalks has proven most successful.

By the use of one or the other of these methods of protecting plants the peach has been grown and successfully fruited in the southern central part of South Dakota, along the Missouri River.

Besides these protective devices, sheltered places, where growth is retarded in spring, may be taken advantage of in order to hold back such early blooming plants as apricots, Japanese plums, etc. Apricots planted and trained on the north wall of a building are frequently sufficiently retarded at blooming time to insure a crop, while if planted in the open and trained as a standard the fruit crop will be killed by late spring frosts.

For commercial purposes the use of most of these protective measures are precluded on account of expense. The commercial grower can not indulge in such expensive devices unless he has the assurance of obtaining a fancy price for his product. In a home fruit garden, however, it is different. The expense of protecting a half dozen plants is trifling, and many amateurs will incur it for the sake of the novelty of having secured fruits naturally adapted to other climatic regions.

METHODS OF ADAPTING PLANTS TO CONDITIONS.

DWARFING AND GRAFTING.

In order to secure satisfactory results from a limited area devoted to fruit culture, one must know the form of plant and method of pruning, training, and culture best suited to the space at command.

The fact that trees can be grown as *dwarfs* as well as *standards* will enable one to utilize a space which had previously been considered unsuited for the development of a tree. The cultivator's art has developed many devices which may be used to make plants conform to the conditions in a fruit garden.

The modifications which plants undergo are sufficient to convince one of the great possibilities which await those who choose to make use of the methods to secure a large return from a limited area. It is well known that, in proportion to size, dwarf trees are more fruitful than standards; that they come into bearing sooner, and are therefore of special value for use in limited inclosures or fruit gardens.

Dwarfing is accomplished by budding or grafting robust growers on slow-growing stocks, and most tree fruits lend themselves to this

treatment. While the dwarf pear is undoubtedly the most familiar example of a dwarf tree in the United States, there are stocks upon which apples, cherries, plums, and peaches can be grown with the same general result. Besides this form of modification, there are other methods quite as important to the owners of small areas. Standards may be grown as "bushes" or as "pyramids," thus making it possible to grow them much closer together. Pruning and training, used in combination, have shown the possibilities of restricting plants to the "espalier," "cordon," and other styles of training employed in grow-

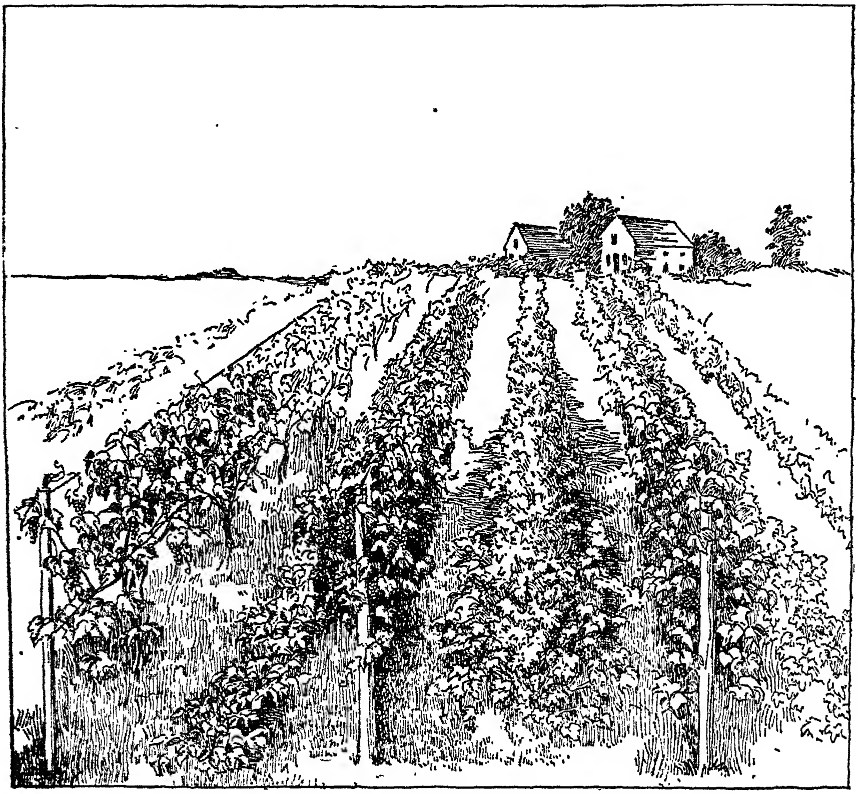


FIG. 31.—Combination of strawberries and currants with grapes.

ing fruits against walls. These methods not only allow plants to be grown more closely than is common in orchard practice, but they allow the grower to take advantage of locations and conditions under which trees could not develop normally. The side of a building may be utilized as a support to an apricot, nectarine, pear, or grape, the last named being the only one normally adapted to such a position.

Besides the advantage of dwarfing, grafting may be turned to good account to enable the owner of few trees to increase his sorts beyond the limits of the trees he possesses. By grafting, the list of varieties

can be increased almost at will. There are single trees known which bear as many as 150 varieties of apples. While a tree of this kind possesses little commercial value, it is of interest in the way of proving what can be accomplished by grafting.

COMBINING PLANTS OF VARIOUS HABITS OF GROWTH.

In addition to the advantages to be gained from restricting the growth of plants by training and dwarfing, some of the methods of training offer adaptations which allow of combining plants of various habits of growth, to the advantage of the grower and with little or no disadvantage to the plants. To illustrate this, currants may be combined with the grape, as shown at the right in fig. 31; the apples with currants or raspberries, as in fig. 32; grapes and strawberries, as shown at the left in fig. 31.

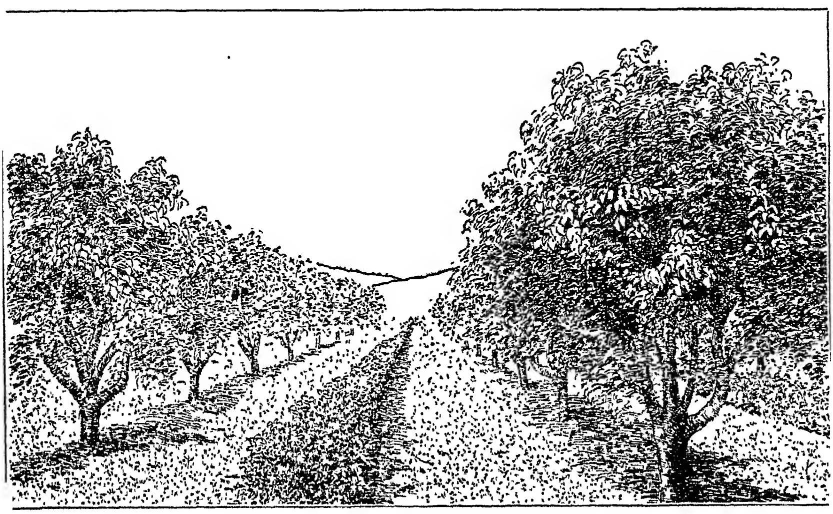


FIG. 32.—Raspberries between apple trees.

The advantages of these methods become apparent at once when the object is the most economical utilization of a limited land area.

Besides the special adaptations afforded by dwarfed trees and by special combinations of low-growing and high-growing plants, certain well-known systems of pruning and training allow additional liberties to the skillful planter, as, for instance, the grapevine, which readily lends itself to arbor training, may be utilized for screening tender or shade-loving plants. The style of training the grape shown in fig. 33 is more desirable in many cases than a more perfect arbor. Strawberries adapt themselves readily to such situations if the shade is not allowed to become too dense. Among flowering plants none will thrive better under such conditions than pansies and violets, and among garden vegetables lettuce and radishes may be successfully grown under such a

canopy, as they will be out of the way before a dense shade is formed by the grapes. Asparagus can be successfully grown under a shade of this character, as it will, because of its early habit, make a large share of its growth before the tardy grape will have produced a shade dense enough to interfere with the young, tender shoots.

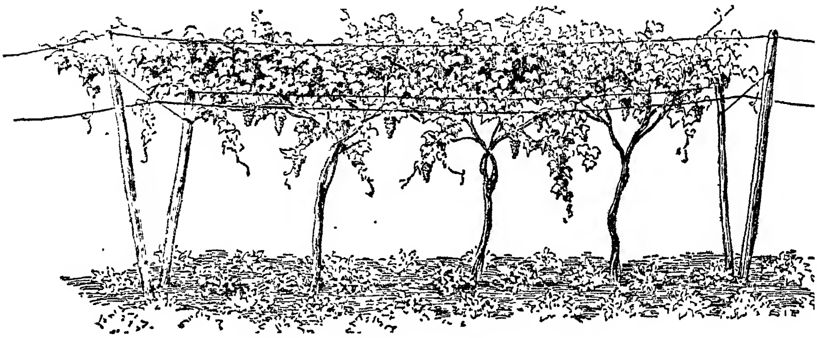


FIG. 33.—Strawberries under grape vines.

The vine may be utilized as a cover for walks and drives or a
nopy over small outbuildings. A cozy summer veranda may
vered by grapevines, thus securing the double advantage of a co
ady nook during summer and a supply of fruit in autumn. Fig.
ows a back porch shaded in this way. In one garden a small ash ho
as made to support an Isabella vine, and this vine in 1891 produced

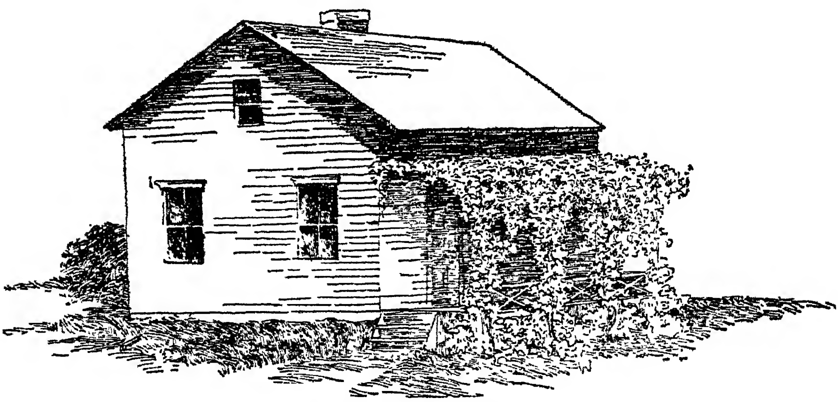


FIG. 34.—A vine-clad porch.

clusters of grapes. The small inclosure in which this vine grew, only 25 feet wide and 80 feet deep, also supplied foot room for 15 other grapevines, several dozen strawberry plants, a row of currants, and a limited supply of vegetables and annual flowers, besides a few square yards of beautiful turf. The plan of this garden (fig. 35) shows the arrangement of the plants. The grapevines are trained to the high,

tight board fence which separates the lot from that of the next neighbor. The currants are planted near one side of the inclosure, while the main walk occupies a corresponding position on the opposite side. The area between the walk and fence on one side is given up to strawberries, while that between the walk and currant bushes on the opposite side forms the flower and vegetable plat.

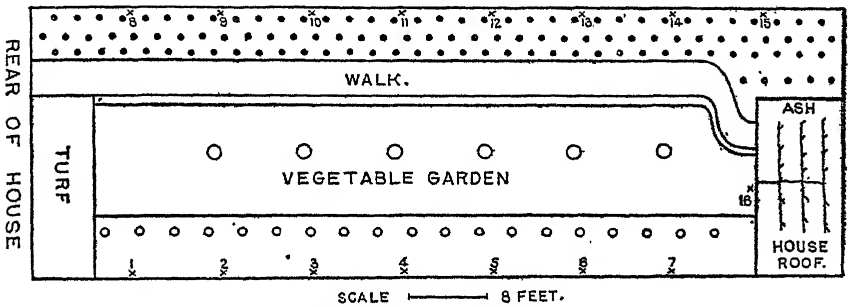


FIG. 35.—Plan of a back yard 25 by 80 feet in extent: ×, Grapes; •, strawberries; o, currants; O, dwarf peas.

COMBINED FRUIT AND VEGETABLE GARDEN.

Where there is more land at one's disposal, there may be both a fruit garden and a vegetable garden. An area of 60 by 80 feet set apart as a fruit garden will accommodate 442 fruit-bearing plants of the kinds designated below, while an area of 40 by 80 feet will be sufficient for quite a variety of vegetable plants. On these areas, planned as shown in fig. 36, fruit and vegetable plants may be grown as follows:

Fruit-bearing plants that can be grown on an area of 60 by 80 feet.

Thirty-two grapevines, dispersed at intervals of 10 feet around the entire garden.
Three rows, each containing 6 trees dwarf pears, 18 specimens in all (rows No. 2, 10, 14).
One row, 6 specimens peaches (row No. 4).
One row, 6 specimens cherries (row No. 8).
One row, 6 specimens dwarf apples (row No. 6).
One row, 6 specimens plums (row No. 12).
One row, 20 specimens blackberries (row No. 1).
Two rows, 40 specimens black caps (rows Nos. 3 and 5).
Two rows, 40 specimens red raspberries (rows Nos. 7 and 9).
Three rows, 300 specimens strawberries (rows Nos. 11, 13, and 15).

Vegetable plants that can be grown on an area of 40 by 80 feet.

One row, ½ row rhubarb, ½ row asparagus (occupying 4 feet).
One row, salsify (1½ feet).
One row, parsnips (1½ feet).
Two rows, beets (3 feet).
One row, eggplant—plants set 18 inches apart—2 dozen (3 feet).
Two rows, tomatoes—plants set 2 feet apart—2 dozen (6 feet).
One row, summer squash, 12 hills, 3 feet apart (3 feet).

Two rows, cucumber, 24 hills, 3 feet apart (6 feet).

Two rows, early cabbage, 4 dozen plants, set 18 inches apart (4 feet).

Two rows, late cabbage, 4 dozen plants, set 18 inches apart (4 feet).

One row, early celery, 6 dozen plants, set 6 inches apart (2 feet).

Eight rows, peas, plant in double rows, 4 inches apart, follow by 6 rows late celery, 36 dozen plants (16 feet).

Two rows, lima beans, 4 dozen hills, 18 inches apart (4 feet).

Six rows, bunch beans; in succession sow seeds in drills, placing seeds about 6 inches apart in the row; follow by late cabbage, turnips, or spinach (12 feet).

Two rows, radishes, 4 sowings planted in double rows 6 inches apart (3 feet).

Two rows, lettuce, two sorts adapted for early and late use (3 feet).

One row, parsley and peppergrass ($1\frac{1}{2}$ feet).

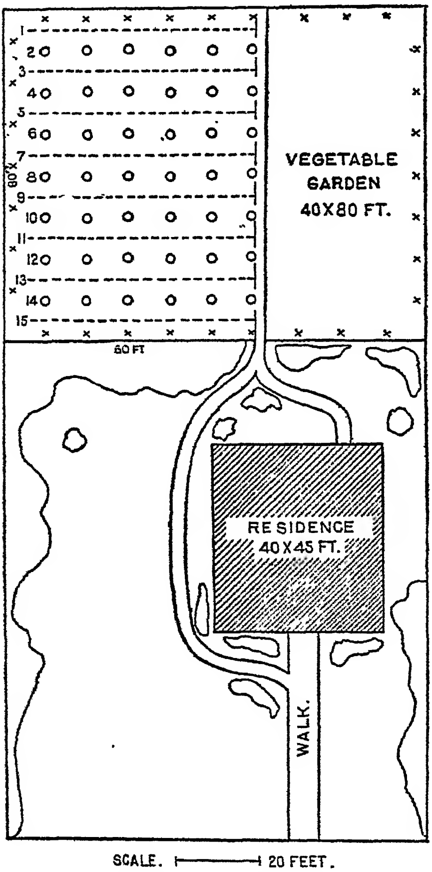


FIG. 36.—Plan for a suburban place.

The space occupied by the last three plants may be given over to winter squashes by planting these before other crops are off the ground.

As before mentioned, the general plan will serve as a guide to planting in any portion of the United States, but the sorts chosen must be suited to that particular section of the country in which the work is to be executed.

As will be seen by fig. 36, this garden is planned to utilize the space to the best possible advantage. In order to secure large returns, the soil must be kept cultivated and well enriched; walks, if any are to be maintained as permanent features, should only exist where necessary for ease and comfort in getting about. A permanent walk should divide the fruit garden from the vegetable garden. This is best made of gravel or some other loose material, which will preserve a dry passageway without preventing the rain from penetrating the soil beneath it, as the fruit trees which stand beside it will need the moisture which it gathers. On account of the small area occupied and the close planting necessary to secure the result desired, the culture of such a garden must of necessity be done by hand. If the grapevines are trained on the

high renewal system, they will serve both as a screen for the rest of the garden and as a source of fruit supply. A good wire fence should, however, be constructed on the line between adjoining properties, and the grape border planted not farther than 2 feet from the boundary fence.

ALLOTMENT OF FRUITS FOR GARDENS OF DIFFERENT SIZES.

The following lists of varieties, while made for northern Ohio, are presented more as a guide to the proportionate allotment of plants of various species in a home fruit garden than as a guide to varieties suited to such a garden. As has already been pointed out, the selection of sorts for a fruit garden is a local as well as personal matter. Varieties give their best products only in certain more or less restricted areas, so the list of fruits in one section will naturally differ widely from those in another. Then, too, the personal likes of the planter will modify the list in each garden, even though the conditions be such as to admit of a duplicate set in each.

Varieties of fruits for home gardens of different areas.

FRUIT GARDEN NO. 1 (ABOUT 2 ACRES).

APPLES (24 TREES).—*Summer:* Two Early Harvest, 2 Red Astrachan, 1 Golden Sweet, 1 Pumpkin Sweet, 1 Maiden Blush. *Winter:* Two Grimes Golden, 2 Baldwin, 2 Rhode Island Greening, 2 Belmont (White Pippin), 1 Fallawater, 1 Fameuse (Snow Apple), 1 Talman Sweet, 1 Roxbury Russet. *Crab:* One Hyslop, 1 Transcendent, 1 Yellow Siberian.

PEACHES (25 TREES).—*Early:* Four Yellow Rareripe, 4 Early Crawford, 4 Elberta, 2 Alexander, 2 Canada Early, 1 Lewis. *Late:* Four Late Crawford, 2 Stephens Rareripe, 2 Golden Drop.

PEARS (10 TREES.)—Four Bartlett, 2 Koonce, 2 Duchess, 1 Kieffer, 1 Warden Seckel.

CHERRIES (10 TREES).—Four Allen, 2 Black Tartarian, 4 Early Richmond.

PLUMS (10 TREES).—Two Green Gage, 2 French Damson, 2 Lombard, 2 Mary, 2 Willard.

QUINCES.—Fifteen Champion.

APRICOTS.—Five Montezumet.

NECTARINES.—Five Boston.

GRAPES (100 VINES).—Twenty-five Concord, 25 Campbell's Early, 25 Niagara, 25 Brighton.

RASPBERRIES (150 BUSHES).—Fifty Gregg, 25 Marlboro, 50 Cuthbert, 25 Golden Queen.

BLACKBERRIES (100 BUSHES).—Fifty Agawam, 50 Taylor.

CURRANTS (100 BUSHES).—Fifty Victoria, 25 White Grape, 25 Black Champion.

GOOSEBERRIES (75 BUSHES).—Twenty-five Downing, 25 Industry, 25 Columbus.

STRAWBERRIES (400 PLANTS).—One hundred Brandywine, 100 Glen Mary, 100 Warfield, 100 Gandy.

FRUIT GARDEN NO. 2 (FOR MEDIUM-SIZE PLACE).

APPLES (10 TREES).—Two Baldwin, 2 Grimes Golden, 1 Fallawater, 2 Red Astrachan, 1 Bough Sweet. *Crab:* One Transcendent.

PEACHES (10 TREES).—One Alexander, 2 Yellow Rareripe, 2 Early Crawford, 4 Late Crawford, 1 Stephens Rareripe.

CHERRIES (5 TREES).—Two Early Richmond, 2 Black Tartarian, 1 Allen.

PLUMS (5 TREES).—Two Green Gage, 2 Lombard, 1 Willard.

PEARS (5 TREES).—Two Bartlett, 1 Duchess, 1 Kieffer, 1 Seckel.

QUINCES.—Five Champion.

APRICOTS.—Two Montezumet.

NECTARINES.—Two Boston.

GRAPES (50 VINES).—Twenty-five Concord, 10 Niagara, 15 Brighton.

RASPBERRIES (70 BUSHES).—Twenty-five Gregg, 10 Marlboro, 25 Cuthbert, 10 Golden Queen.

BLACKBERRIES (50 BUSHES).—Twenty-five Agawam, 25 Taylor.

CURRANTS (45 BUSHES).—Twenty-five Wilder, 10 White Grape, 10 Black Champion.

GOOSEBERRIES (30 BUSHES).—Ten Downing, 10 Industry, 10 Columbus.

STRAWBERRIES (200 PLANTS).—One hundred Brandywine, 100 Gandy.

FRUIT GARDEN NO. 3 (FOR CITY LOT).

APPLES (4 TREES).—One Red Astrachan, 1 Golden Sweet, 1 Baldwin, 1 Fallawater.

PEACHES (4 TREES).—One Canada Early, 1 Yellow Rareripe, 1 Early Crawford, 1 Late Crawford.

PEARS (2 TREES).—One Bartlett, 1 Duchess (Dwarf).

PLUMS (2 TREES).—One Willard, 1 Lombard.

QUINCES.—Two Champion.

APRICOTS.—One Montezumet.

GRAPES (10 VINES).—Five Concord, 5 Niagara.

RASPBERRIES (20 BUSHES).—Ten Gregg, 10 Cuthbert.

BLACKBERRIES (20 BUSHES).—Ten Taylor, 10 Agawam.

CURRANTS (10 BUSHES).—Five Victoria, 5 White Grape.

GOOSEBERRIES.—Five Downing.

STRAWBERRIES.—Fifty Brandywine.

TWO VANISHING GAME BIRDS—THE WOODCOCK AND THE WOOD DUCK.

By A. K. Fisher,
Ornithologist, Biological Survey.

Introduction.

Unless strong protective measures are soon adopted the woodcock and wood duck, two popular and valuable game birds, will become extinct—the woodcock absolutely, the wood duck over a large part of its range. It is the purpose of the present paper to call attention to the impending extinction of these birds, to point out the causes, and, so far as possible, to suggest means of prevention.

These game birds differ materially in habits as well as in other particulars, but the conditions affecting their decrease are very similar. As winter approaches they leave their summer homes, where they have been scattered over broad areas, and gradually work southward until finally they become more or less concentrated in their respective haunts in the Southern States. Within the confines of this winter home, where almost no protection is afforded them, they are slaughtered in large numbers; and as the Southern States place little restriction on their export, they are shipped North in quantities limited mainly by the demands of the market or the endurance of the gunners. Not only are the birds subjected to this exterminating treatment throughout the winter, but when the season of migration comes and they return to their summer homes they fare little better; for a majority of the States in which they are found permit them to be shot while nesting or at the time when the young are unable to properly care for themselves. In view of these facts it is not surprising that the woodcock, with its limited distribution and moderate fecundity, is very rapidly passing away, and that the wood duck has disappeared or become rare in many places where once it was common.

Woodcock.

(*Philohela minor.*)

It is probably true that none of our game birds is so universally esteemed as the woodcock. (Pl. LXIII.) The many sportsmen who find pleasure in following coveys of bobwhite through stubble field and covert in autumn, and those who enter the wild and rugged haunts of the ruffed grouse, frequently abandon their chosen pursuit to search alder swamp or hazel hillside to add the woodcock to their bag. Nor is the bird a favorite with sportsmen alone; it is equally highly

regarded by the epicure, and to fill the demand for the table it is much sought by those who shoot to supply the market. The high price it commands is a great incentive to its slaughter at unseasonable times, and this is the most potent factor working to its ultimate extinction.

DISTRIBUTION.

The woodcock is an inhabitant of the Eastern United States, and is rare or accidental west of the ninety-seventh degree of longitude and north of eastern Manitoba, the Great Lakes, and the Ottawa and St. Lawrence rivers. Its true home is the Mississippi Valley and the northern and middle tiers of States, where cane or alder swamps abound, and where springy hillsides and marshy ground along the

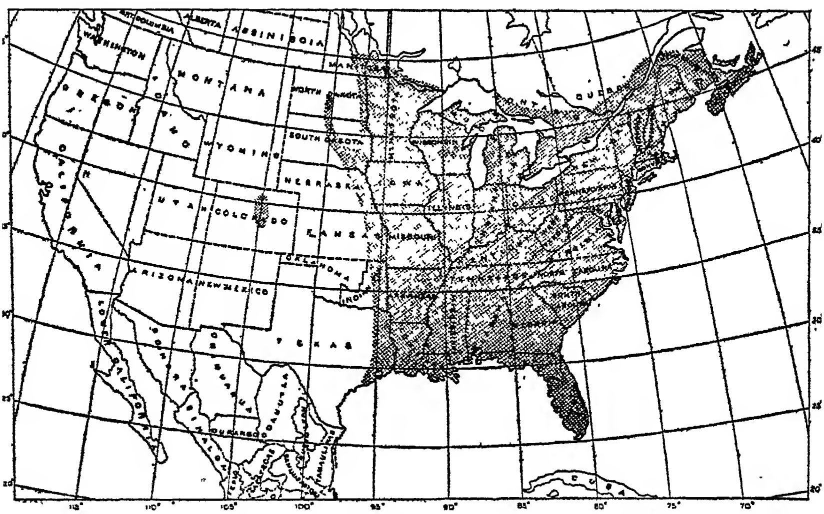


FIG. 37.—Distribution of the woodcock (*Philohela minor*): Shaded area shows range of species.

streams furnish extensive feeding places. In winter it is to be found chiefly in the South Atlantic and Gulf States, particularly in the extensive alluvial tracts of Georgia and Louisiana, although in mild seasons a few may winter about open spring holes as far north as the southern parts of Illinois and New York.

To the west of the States which lie along the western bank of the Mississippi, swamps affording suitable food and shelter are rare, and here, except for a few records of its appearance in the region just east of the foothill country of Colorado, and one recent breeding record from Timnath, in the same State, the woodcock is practically unknown. There is no satisfactory evidence that the bird ever visits any of the West Indian islands; so far as known, the only extralimital record is one of a storm-driven waif which reached the Bermudas. (See fig. 37.)

Woodcock are early migrants, reaching the latitude of New York by the 1st of March, and in favorable seasons at least two weeks earlier. As they breed throughout their range, the time of nesting is quite varied. At Covington, La., young birds fully 10 days old have been found as early as January 29, and in Florida, it is stated, eggs are deposited early in February. This is fully a month in advance of the time of nesting in southern Illinois and the vicinity of Washington, D. C., and more than two months earlier than the regular nesting season in the latitude of New England. In the more northern parts of the range it is often as late as June before the young appear, and well into July before they are wholly able to care for themselves.

HABITS.

The general appearance of the woodcock clearly suggests its nocturnal or crepuscular habits. During the brighter parts of the day it seldom takes wing unless disturbed, though it may perhaps feed in secluded places during dark, cloudy weather, or when protected by unusually thick cover. When dusk comes, however, it is all activity, and leaves its hiding place to visit the feeding grounds in marshes, along streams in low meadows, or in fields of growing corn. In favorable localities, woodcock can be heard at dusk flying back and forth, and occasionally the glimmer of their wings can be seen as they alight in the open. In former days, before they had become too scarce, it was a common sight from early twilight until dark to see or hear them flying about the open pastures or springy hillsides of northern New York, nor was it a rare event to flush them from the kitchen garden or barnyard, or even from shrubbery close to the house, where they had come in search of food.

The flight is variable, not only in character, but also in force and swiftness: at times, when the bird is flushed, its movements are seemingly labored and irregular as it zigzags up toward the tree tops; at other times it has the swift, regular motion characteristic of other members of the group.

The earthworm is the staple food, and the presence or absence of this annelid doubtless governs to a great extent the distribution of the bird, though other forms of subterrestrial life, especially the larvæ of insects, undoubtedly make up a portion of its daily fare. It has been shown that a woodcock weighing 6 ounces devours at least half a pound of worms in twenty-four hours, and during protracted droughts there must be difficulty in satisfying this voracious appetite.

The nest, a loose structure of grass or other herbage, is usually placed among the leaves in a more or less elevated part of the swamp, out of danger of rising water. The eggs are buffy in color, mottled or spotted with darker shades, and are generally 4 in number.

THE DANGER OF EXTERMINATION.

The growing scarcity of woodcock is a matter of serious alarm, and one demanding prompt action. It must be remembered that there is far more difficulty in saving it from extinction than in preserving gallinaceous birds, such as quail and grouse. In the case of these birds, with their extraordinary fecundity, it is not difficult to restore a depleted covert; for with the addition of a few imported birds, aided by a short term of protection, they should soon reach their former abundance. With the woodcock, however, the situation is different; for the impracticability of restocking, the nature of the food, the migratory habits, and the small number of young are serious obstacles to successful restoration. Quick and effective measures are needed. In many localities in the North where twenty-five years ago a fair shot with a good dog could secure 40 or 50 birds in a day's hunt it is doubtful if 10 per cent of the former bag could now be obtained. During the past autumn (1901) the writer visited hundreds of acres of good woodcock ground in northern New York without flushing a bird or seeing any considerable signs. Reports as to the scarcity of birds come from numerous points, and even in the most favored localities the decrease within the past twenty years has been 50 to 60 per cent.

The causes that have led to this deplorable state of affairs may be summarized as follows (the first two being of minor importance compared with the last two): (1) Natural enemies; (2) severe storms during migration; (3) lack of protection in winter; (4) spring and summer shooting.

NATURAL ENEMIES.

Although there is little positive information on which to base an opinion, still it is probable that the cat, red squirrel, sharp-shinned hawk, and mink are among the most important natural enemies of the woodcock. If the influence exerted by man be eliminated, natural enemies doubtless produce, within certain limits, a beneficial rather than injurious effect on a species as a whole. As pointed out years ago by Professor Baird, the weak, diseased, or wounded individuals, on account of their lessened activity, are almost sure to be the first to fall victims, whereas the strong and vigorous, through their agility and alertness, have comparatively little difficulty in eluding their foes. By the removal of the weaklings, disease and degeneracy are kept away from the breeding stock, which is able through its healthy vigor to escape epidemics and other sweeping fatalities. It is only when man lends a heavy hand in the work of destruction that the inroads of natural enemies ever become apparent. The man who in a few days kills 500 or 600 birds, or even half that number (a destruction far beyond his needs), is much more of a menace to game than the passing hawk, which takes only the food it requires.

STORMS DURING MIGRATION.

Cold storms in spring often are very destructive to bird life, especially when accompanied by snow or occurring in the height of migration. Mr. Arthur T. Wayne gives the following account of the effect on the woodcock of a cold wave which struck the coast of South Carolina February 13 and 14, 1899:

> The Woodcock (*Philohela minor*) arrived in countless thousands. Prior to their arrival I had seen but two birds the entire winter. They were everywhere and were completely bewildered. Tens of thousands were killed by would-be sportsmen, and thousands were frozen to death. The great majority were so emaciated that they were practically feathers and of course were unable to withstand the cold. One man killed 200 pairs in a few hours. I shot a dozen birds. Late Tuesday afternoon I easily caught several birds on the snow and put them into a thawed spot on the edge of a swift running stream in order that they would not perish, but upon going to the place the next morning I found one frozen. These were fearfully emaciated and could scarcely fly. Two birds were killed in Charleston in Broad street. It will be many years before this fine bird can establish itself under most favorable conditions.[1]

LACK OF PROTECTION IN WINTER.

During the winter practically all woodcock inhabiting the United States are massed within the borders of the South Atlantic and Gulf States. It may be stated without fear of contradiction that the wider the area over which a species is distributed the less danger there is of its extinction; and conversely, the smaller the area of distribution the greater the danger of extinction. It would seem that when a desirable species takes up its habitation in a certain region the residents of that region would encourage its presence and give it some sort of protection. But the history of the bison, wild pigeon, and many other mammals and birds shows that such support can not be depended on. Nor does the woodcock form an exception. Of the nine States within whose borders most of the woodcock make their winter home, seven (namely, North Carolina, Georgia, Florida, Mississippi, Arkansas, Louisiana, and Texas) give the birds absolutely no protection—all winter long from the arrival in the fall until the departure in the spring they are killed ruthlessly. Moreover, none of these States prohibit the shipment of woodcock, which consequently can be sent to market without restriction. The other two States (Alabama and South Carolina) protect the birds, the former from March 2 to November 15, the latter from April 1 to November 1, and if January 1 were substituted for the first date in each case, thus cutting off spring shooting, these seasons would be ideal.

SPRING AND SUMMER SHOOTING.

Fortunately, a number of States that formerly countenanced the unseasonable slaughter of woodcock in spring or summer (which is

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[1] The Auk, Vol. XVI, p. 197.

only comparable to killing nursing does or taking trout from the spawning beds) have now enacted proper laws. Nevertheless, spring or summer shooting, deplorable as it must seem to anyone who has even a passing interest in the bird, still exists in half the States which have protecting seasons.[1] Twenty-six States and the District of Columbia give protection for at least part of the year. (See diagram, fig. 38.) Of these, Virginia, South Carolina, Alabama, and Tennessee still tolerate spring shooting. The season closes in Virginia and South Carolina on the 1st of April, and in the other two States a month earlier. It is pretty certain that in Alabama and Tennessee the summer residents commence nesting early in February, and that in South Carolina and Virginia they have eggs, or possibly young, by the middle of March. Consequently, four eggs, or as many callow young, are apt to perish with each pair of birds shot during the two or three weeks prior to the close of the season in those States.

Summer shooting is still permitted in nine States and the District of Columbia and on Long Island. It begins on June 20 in Kentucky; on July 1 in the District of Columbia and Indiana; on or before July 15 in West Virginia, Minnesota, and Iowa; on August 1 in Missouri and on Long Island; and is restricted to the month of July in Pennsylvania, New Jersey, and Maryland. There are no statistics to show what proportion of the young birds hunted are able to fly as early as July, but judging from the experience of ornithologists and the statements of a few market hunters the proportion must be large. One rather frank market hunter stated that he quite often killed the parent and young without moving from the position where the birds were first flushed. He would kill one or two as they took wing, and secure the others on the ground when they had alighted, usually within a hundred feet of the point at which they were flushed.

If a locality is closely hunted during the summer most of the birds are killed, and not enough are left to keep up the breeding stock. The District of Columbia is a good example of the pernicious effects of this unseasonable shooting. Twenty-five years ago there was hardly a swamp of any size that did not have its pair of breeding woodcock. It is stated that at least two pairs bred every summer within the limits of the present Zoological Park, and that it was not rare to flush a bird in the less populous sections of the city. At present, breeding birds are far more difficult to find; it is doubtful if they equal 10 per cent of the former number.

PREVENTIVE MEASURES.

To prevent any further decrease of the woodcock, one of the first steps is to abolish all spring and summer shooting. It has been shown

[1] Ten States, which in the aggregate include nearly half the area inhabited by the woodcock, give it absolutely no protection.

that spring shooting is harmful on account of the number of parent birds killed, either when nesting or while caring for dependent young.

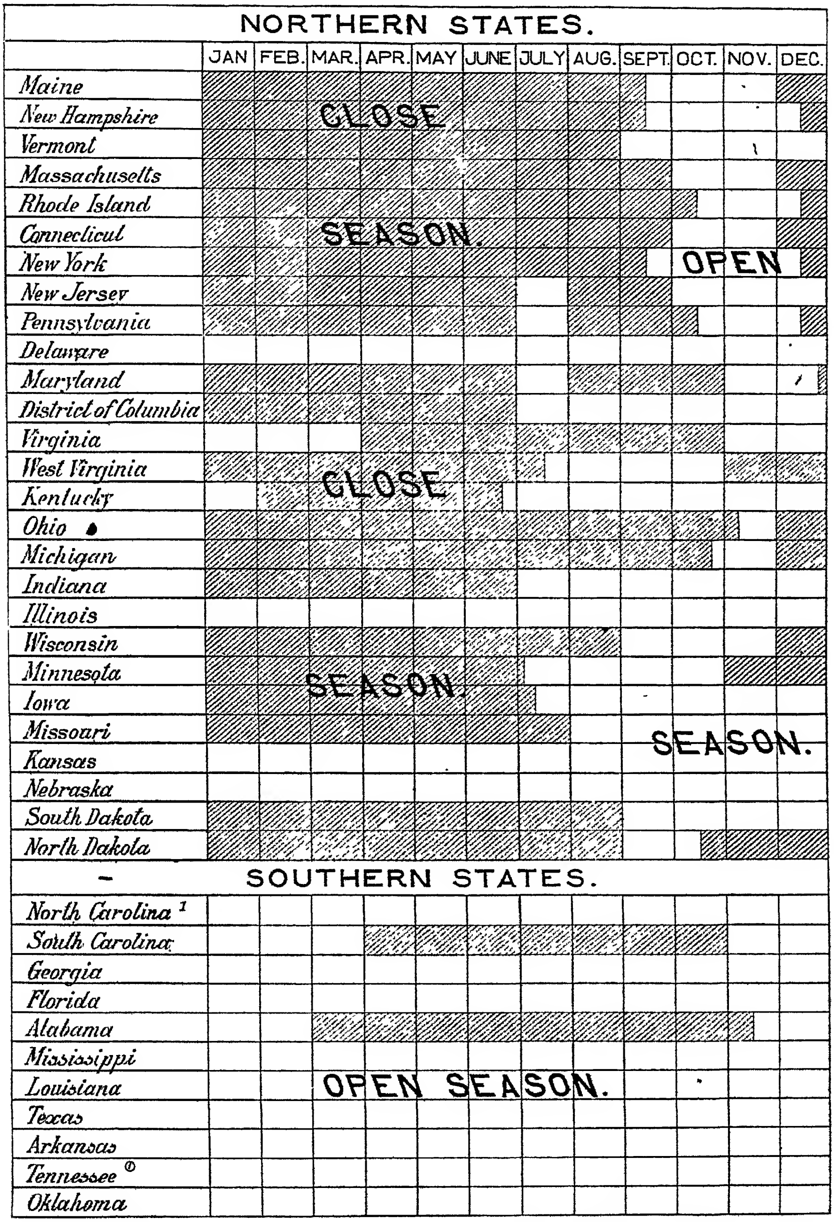

FIG. 38.—Close and open seasons for woodcock in 1901: [1] Partial protection in certain counties.

Summer shooting is even more disastrous: in many localities practically all the resident birds are destroyed before the young are strong enough to care for themselves.

In the Southern States, where the bird winters, and where it has utterly inadequate protection, the sportsmen should rally, and by concerted action make a strong effort to have proper laws enacted. A short open season of not over six weeks should take the place of the present practically unrestricted one; a limit should be placed on the size of the bag; and, beyond allowing a sportsman to carry a few birds with him on his return home, all shipment should be prohibited.

With the adoption of the measures here suggested the principal danger would be averted, and if, in addition, sportsmen and others would take an unselfish view of the matter and work for a universal close season covering two or three years, the restoration of this noble bird would be assured. One locality has already taken this course. In Rensselaer County, N. Y., woodcock can not be lawfully shot until 1903. If this creditable example were to be generally followed throughout the region inhabited by the woodcock there could be no question as to the result. Such action on the part of the Northern States would have the cooperation of Ontario, which has a law empowering it to act with two or more of the States lying to the south of that Province (one of such States being either New York, Pennsylvania, or Michigan) in prohibiting for a period all hunting, shooting, and sale of any migratory game bird that appears to be in danger of extinction.[1]

Unless sportsmen and others especially interested will take this matter in hand and secure proper legislation for the better protection of the woodcock, future generations will have cause to grieve over the loss of one of the finest game birds that ever graced a covert.

Wood Duck.

(*Aix sponsa.*)

The wood duck (Pl. LXIV), or summer duck, is the most beautiful of all the members of the large and diversified duck family, and, on account of its beauty and lack of shyness, is one of the best known species in the country. It is not seclusive, often making its abode near towns, or perhaps in the vicinity of farmhouses, where it may be found feeding or associating with barnyard ducks. It takes kindly to domestication, and is easily tamed and induced to breed in captivity. Its favorite haunts are small lakes, weedy ponds, or shady streams in the midst of, or in close proximity to, scattered woodlands, and, except during migration, it is rarely met with about open bays or large bodies of water.

[1] New York within the past year has taken steps looking to the establishment of such cooperation as Ontario suggests. The game warden of that State has communicated with game associations in several States with a view to establishing, in conjunction with Ontario, a close season for woodcock and wood ducks for a term of years.

THE WOO PHILOH

THE WOOD DUCK (AIX SPONSA).

DISTRIBUTION.

The wood duck is found from Nova Scotia, New Brunswick, and Ontario westward to British Columbia, and southward through the United States to its southern border and Cuba. It is rather uncommon in the eastern Canadian Provinces, but in parts of Manitoba and British Columbia it is abundant. In the Saskatchewan region it has been found as far north as latitude 54°, and on the west shore of Hudson Bay as high as latitude 60°, but it is rare north of latitude 50°.

In the United States it is commonly distributed in the Mississippi Valley and eastward, as well as along the Pacific coast from Washington to southern California, but, except in a few isolated localities, it is very rare or absent in the Great Basin, Rocky Mountain, and Great Plains regions. Although it is common in Texas, evidences of its occurrence in Mexico are unsatisfactory, though it probably may be found in the more northern portion during winter. It is resident in Cuba, and stragglers have been taken in Jamaica and Bermuda. It breeds throughout the greater part of its range, and since over a considerable part of its breeding area it is the only representative of the duck family during the nesting season, the name "summer duck," by which it is often designated, is very appropriate.

HABITS.

In the South the wood duck commences to breed early in March, and in the more northern parts of the range about a month later. In Florida and Texas full complements of eggs have been found by the 1st of April; in Maine by May 10. The nests are almost invariably placed in cavities in trunks or limbs of trees, often at a considerable height from the ground, and are occasionally quite a distance from water. The eggs, which vary in number from six to fifteen, according to the age of the bird, resemble old ivory in color.

While the females are incubating or caring for the young, the drakes of a neighborhood band together and may be seen flying about or feeding in company. Observers differ as to whether these bands remain unbroken and aloof from the females and young through the entire brooding period or separate at intervals during the day to visit their mates.

The flight of the wood duck is swift and graceful, and the bird rivals the grouse and quail in the ease and facility with which it glides through the woods and among the branches.

The food consists of various kinds of insects, the seeds and leaves of aquatic plants, and beechnuts, chestnuts, and acorns. Its fondness for the latter, on which it feeds largely in autumn, gives it in some localities the name "acorn duck."

SPRING SHOOTING.

Within the past few years friends of game protection have felt encouraged not only by the apparent awakening of a more healthy public sentiment against undue destruction of birds and mammals, but also by the progressive movement in the direction of more extended and more uniform close seasons. But although much has been done for the protection of upland game, little has been accomplished toward saving the waterfowl. Unaccountable as it may seem, ducks are considered legitimate game at a season when they are hurrying to their nesting grounds, and spring shooting is still tolerated in a great majority of the States. Ducks killed in spring are often in wretched condition, and thousands find their way to the big markets that certainly would be condemned as improper food if inspection laws were rigidly enforced.

Let it be said, however, to their lasting credit, that seven States (New Hampshire, Vermont, Michigan, Wisconsin, Minnesota, Utah, and California) and three Canadian Provinces (Manitoba, Ontario, and New Brunswick), by closing the season before February 1, have abolished spring shooting within their borders.

On the other hand, more than half the States permit duck shooting as late as April (see diagram, fig. 39), and at least eighteen allow it throughout this month. It is to be regretted that such States as Iowa, the Dakotas, Montana, Wyoming, and Colorado, which contain large breeding grounds, should be among the number that extend the open season to April or later. This unseasonable slaughter is steadily depleting the ranks of even the most abundant species. And if the migratory ducks (those merely passing on their way to their more northerly breeding grounds) are thus affected, what must be the effect on a species like the wood duck, which breeds over a wide extent of unprotected territory? The question is not hard to answer. It is only necessary to point to the fact that this handsome bird is now almost unknown in many places where once it was common, and where it added both life and attractiveness to the surroundings.

It goes without saying that birds are more easily and more completely destroyed on the breeding grounds than on areas which they merely pass over during migration; for when the breeding season arrives and the nesting site is chosen, birds become less shy and more inclined to remain in the neighborhood, so that gunners (the term "sportsmen" can not be used in this connection), while in search for late migrants, have little difficulty in killing all the wood ducks that are to be found.

Massachusetts and four counties of Maryland recognize the special danger surrounding the wood duck, and make the season much shorter than for other ducks. This is as it should be. But Louisiana reverses the proper course, and permits the wood duck to be killed a month

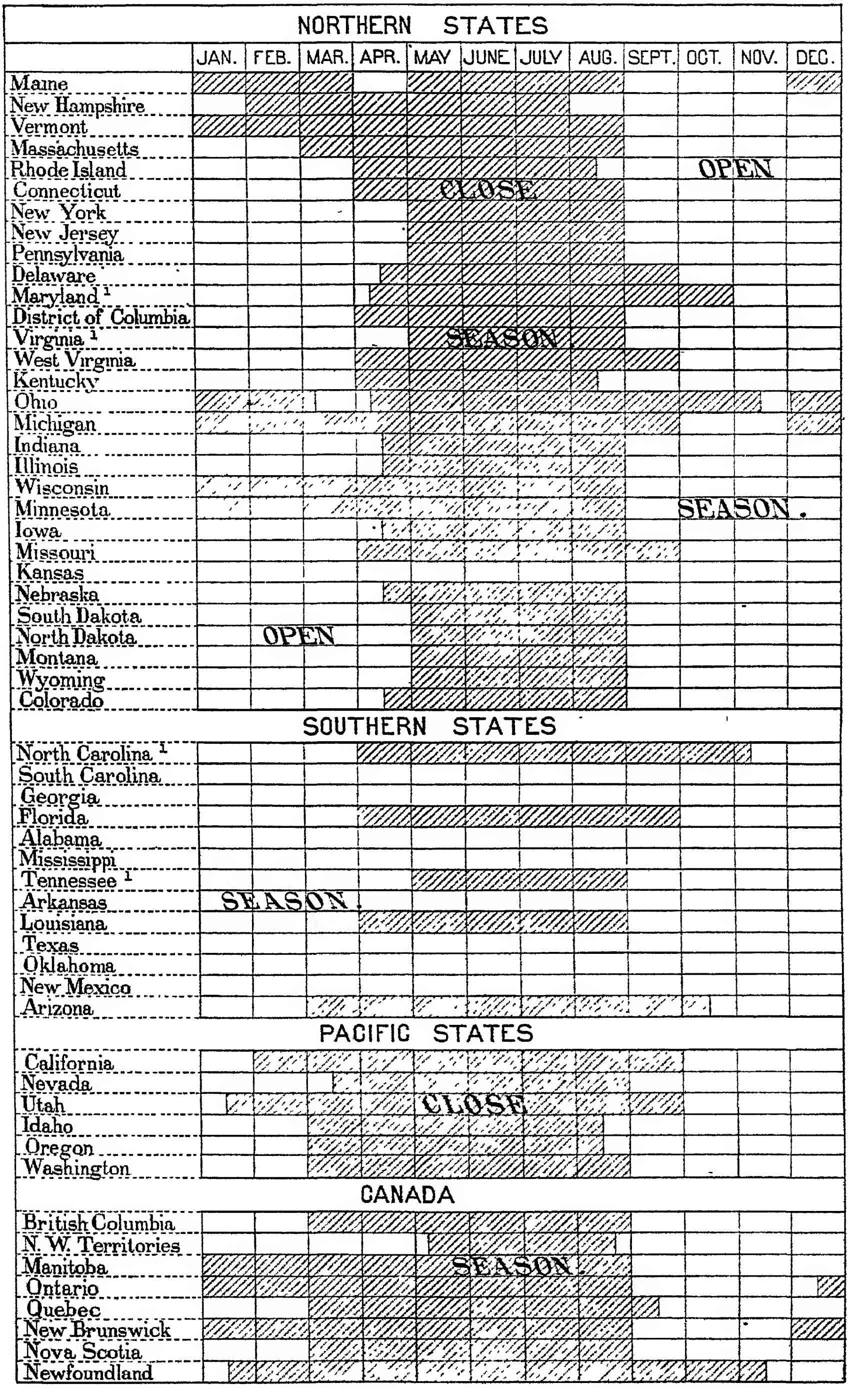

FIG. 39.—Close and open seasons for wild ducks in 1901: [1] Seasons vary in different counties.

after the regular duck season closes; and Delaware, for some unaccountable reason, specifically exempts it from the protection accorded all other ducks.

Jefferson County, N. Y., furnishes one of the most practical and at the same time convincing demonstrations of what sound judgment and proper laws may do for bird protection. The County Sportsmen's Association secured the passage of a law protecting ducks in spring on their breeding grounds, and the following extract from a letter written by the president of the association shows the result of the measure:

> We have claimed as an argument for the passage of this bill that if the fall ducks or divers were unmolested in our waters in the spring, they would find choice feeding spots, and would return earlier and in larger numbers and stay longer in the fall—a fact which yet remains to be proven. We also claimed that if the summer ducks, the black duck, the mallard, the wood duck, and the teal, were unmolested, they would remain with us and nest and rear their young. That they have done so this year is an undisputed fact, as never within the memory of the oldest sportsman have there been so many of these ducks in this county on the opening day.[1]

If in one season such results can be accomplished in a restricted locality surrounded by unprotected areas, it is easy to predict that an enormous increase of birds would follow the universal suppression of spring shooting. But as long as this murderous custom is tolerated, just so long will the wood duck be absent from our ponds and streams. Sportsmen willing to deny themselves a little present sport for the sake of future gain to themselves and posterity should spare no efforts to save and restore this beautiful bird. If spring shooting be abolished the wood duck will gradually return to its old haunts and by degrees reestablish itself—to the joy and satisfaction of all lovers of nature.

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[1] Forest and Stream, Vol. LVII, September 28, 1901, p. 245.

EXPERIMENTAL WORK WITH FUNGOUS DISEASES OF GRASSHOPPERS.

By L. O. Howard, Ph. D.,
Entomologist.

INSECTS AFFECTED BY CONTAGIOUS DISEASES.

It has long been known that when grasshoppers appear in enormous numbers they are apt to die off as a result of some apparently contagious fungous or bacterial disease, and not only are grasshoppers affected in this way, but other insects as well when they swarm in enormous numbers, the chinch bug, for example. In fact, some years ago elaborate experiments were carried on with the contagious diseases of chinch bugs, and for a time it was thought by some that the problem of the chinch bug had been solved by the practical use of one of these diseases, the bugs being artificially infected in the laboratory and distributed to spread the disease among the bugs congregating in the fields. It was found, however, that the spread of the disease was so contingent upon certain weather conditions that while the disease would spread among the uninfected bugs under the most favorable circumstances, it would not spread under other conditions. Moreover, when the favorable conditions occurred it often, if not always, happened that the disease would appear in the armies of bugs without being introduced by the hand of man.

POSSIBILITY OF ARTIFICIAL PROPAGATION OF INSECT DISEASES.

With regard to grasshoppers, however, some work has been done which seems to indicate that there may be a practical side to the artificial propagation of their diseases, and this possibility has seemed sufficiently pronounced to instigate a good deal of work.

The most effective of the diseases of insects are caused by fungi belonging to the group known as the Entomophthoreæ, and this group of fungi has been carefully worked up by Dr. Roland Thaxter, of Harvard University, in a Memoir of the Boston Society of Natural History, published in 1888. Dr. Thaxter, in the course of his studies, concluded that those Entomophthoreæ belonging to Empusa were probably the most effective. One of them destroys the common house fly, as well as other flies; another destroys certain mosquitoes and small gnats and midges; while still another is on occasion an effective enemy of grasshoppers. The latter species is known as *Empusa grylli*. This form also attacks certain caterpillars, as well as grasshoppers,

and it is widespread, being found in many parts of the world. The tendency of a grasshopper or a caterpillar affected by this disease is to crawl upward, usually upon some plant, and to cling tightly after death, in the manner shown in figs. 40 and 41.

In South Africa, in 1896, Mr. Arnold Cooper, of Richmond, Natal, noticed the grasshoppers dying apparently from a fungous disease, and brought specimens to Grahamstown, where, at the Bacteriological

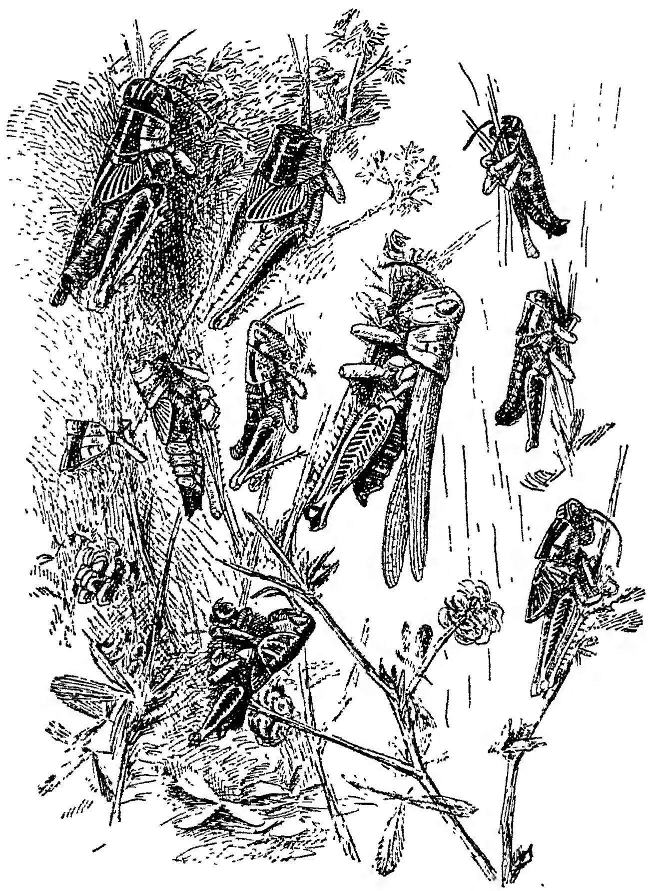

FIG. 40.—A view of grasshoppers dead or dying from entomophthorous disease—natural size (original).

Institute, a fungus was isolated and cultivated upon laboratory culture media, from which healthy grasshoppers were readily affected. Subcultures were made, and vials containing them were distributed to planters in regions where grasshoppers were destructively abundant. Many favorable reports were received. For example, Mr. H. H. Wells, writing in February, 1899, stated that he had received some of the tubes, and on seeing a swarm approaching he dipped several grasshoppers into a fluid containing the fungus and allowed them

to fly among the swarm. He did this for two or three days consecutively, using in all 14 tubes, the grasshoppers in the meantime settling in his orchard and through all his crops. To his profound astonishment in a day or so he found the grasshoppers "hanging in clusters

FIG. 41.—Second view of grasshoppers dead or dying from entomophthorous disease—natural size (original).

all over [his] farm dead—millions of them," and his potatoes and mealies [Indian corn] saved. Other reports of an equally encouraging nature were received at the Bacteriological Institute, and the distribution of the culture tubes continued, although with varying success.

RESULTS OF SOME INVESTIGATIONS OF GRASSHOPPER-DISEASE FUNGUS.

Just what the fungus was does not seem to be thoroughly settled. The reports of results excited a great deal of attention, and people seemed to be satisfied with them, so that the absolutely thorough investigation needed does not seem to have been made. The Entomologist of the Department of Agriculture at Cape Town, Mr. C. P. Lounsbury, has not published the full results of observations which he must have made in this direction, but it may be stated at this point that in his last published report (Report of the Government Entomologist for the year 1900) he states briefly in conclusion, that "the whole question of locusts [grasshoppers] should be given serious attention by Parliament, for the colony will always be subject to invasions, and the artificial distribution of the disease fungus gives no promise of ever proving adequate as a remedy." In 1899 or 1900 some doubt as to the precise nature of the fungus began to be expressed, and the Department of Agriculture of the Cape of Good Hope sent specimens to Kew, England, for examination and report. Mr. Massee, of the Royal Botanic Gardens, examined the specimens and found that they were pure cultures of a species of Mucor, one of the molds, a group of fungi found most usually upon diseased or dead vegetation and dead animal matter, although some Mucors are destructive to fruit. Practically this same determination had previously been made by the Government Vegetable Pathologist of Victoria, Australia, and the value of the cultures sent out from Natal was thus questioned. Mr. Massee, however, found that this Mucor was not at all limited in its choice of a matrix, and in the course of his laboratory experiments found that it killed cockroaches as quickly as it was said to kill grasshoppers. Not only did it kill cockroaches which were sprinkled with water containing the spores of the fungus, but when these, becoming greatly enfeebled, were eaten by healthy individuals, the latter died within twenty-four hours.

It will be remembered that in the letter quoted from Mr. Wells the grasshoppers were said to have been found hanging in clusters, and photographs of dead grasshoppers published at that time by the Bacteriological Institute of Natal shows them clinging to twigs just as though they had been killed by *Empusa grylli*, above referred to. This would indicate that the fungus originally discovered by Mr. Cooper in Natal and at first sent out by the Bacteriological Institute was *Empusa grylli*, and that the late cultures distributed by the institute were Mucors. Certainly, from the report of the Vegetable Pathologist of Victoria, Australia, the tubes received there from South Africa were Mucors and, as we shall soon show, those received in the United States from South Africa were also Mucors. Be this as it may, however, the experiments made by Mr. Massee seem without much doubt to indicate the perhaps unsuspected fact that this Mucor is an insect

killer, and as it is much more readily cultivated than the Empusa, which is such an effective enemy of grasshoppers, the Natal people may not be entirely on the wrong track in their work. In fact, the work done in Victoria, Australia, by Mr. French, the Government Entomologist, seems to have been very successful and to have been carried on with this Mucor. He found that the grasshoppers died some distance away from the place of infection, and were found along ditches and in depressions in the ground in clusters or singly, according to whether the swarms were large or small.

In 1897 Prof. Lawrence Bruner, while employed by the Argentine Republic to investigate grasshopper injury in that country, discovered

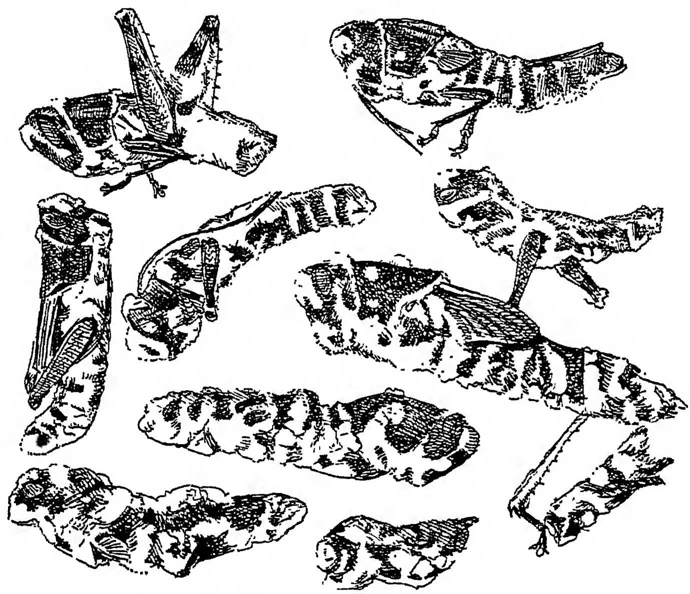

FIG. 42.—Grasshoppers killed by *Sporotrichum globuliferum* (from photograph by Lawrence Bruner).

very many dead grasshoppers which had been destroyed by a fungus of the genus Sporotrichum, the determination having been made by Prof. C. E. Bessey, of the University of Nebraska. These grasshoppers, instead of climbing to the top of various plants, sought dark, moist places, and were found dead near the roots of grasses and in other hidden localities. Professor Bruner found that their bodies after death became filled with a fungus which sometimes appeared on the outside, as shown in fig. 42. Later he found that this fungus could be transmitted from such specimens as those shown in the illustration to live, healthy specimens. It happens that this South American fungus belongs to the same genus as the one that kills the chinch bug in this country, and which is known as *Sporotrichum globuliferum*. Grasshoppers dead with this disease were brought to the United States by

Professor Bruner, but he failed to obtain an artificial growth, the reason being, in his opinion, the age of the material. Nevertheless, he thinks that this fungus is one of the most promising grasshopper enemies, since it attacked several different species and withstood considerable variation in climate.

WORK ON GRASSHOPPER-DISEASE FUNGUS BY THE DEPARTMENT OF AGRICULTURE.

In the winter of 1899–1900 the writer decided to conduct some field experiments with the South African fungus in the United States. He therefore sent to Dr. Edington, the chief of the Bacteriological Institute in Natal, and secured, in the early summer of 1900, three culture tubes containing the fungus. Just at that time reports of extraordinary abundance of grasshoppers in Colorado were received, and two of the tubes were sent on May 28 to Mr. George W. Martin, of Sterling, with printed instructions. These instructions were as follows:

GRASSHOPPER-DISEASE FUNGUS.

[The methods mentioned below should be followed, and the result carefully watched and reported to the office of the Entomologist. During dry weather it is difficult to get the disease to spread, and hence it is advisable to use it in moist or wet weather, and to make the infection of the swarms just before sunset.]

Directions for preparing the fungus previous to use.

Open a tube and take out the contents entire; add it to two teaspoonfuls of sugar, and rub the whole together with a spoon or flat knife so as to break up the material and mix it thoroughly. Then dissolve this in three-quarters of a tumblerful of water, which has previously been boiled and allowed to cool. Float in this a few pieces of cork, which have previously been steeped in boiling water and cooled.

Now cover the tumbler with a piece of paper, and let it stand during the day in a warm corner of the house or until the fungus is seen to be growing around the pieces of cork.

Method of distribution.

(1) Catch some grasshoppers, and, after dipping them into the fungus, let them go into the swarm again.

(2) Smear patches of damp ground, where the grasshoppers alight to feed, with the fungus.

(3) Confine some grasshoppers in a box which contains some favorite food moistened with the fungus, and, after the food has been eaten, return the grasshoppers to the swarm.

(4) Collect a large number of grasshoppers which have died from the fungus. Dig a hole in the ground about 18 inches deep and 1 foot wide. Strew some grasshoppers over the bottom, then sprinkle some water over them. Repeat with grasshoppers, and again sprinkle, until the hole is full. Do not press the grasshoppers into the hole, but leave them lightly packed. Then cover with a piece of tin or board and keep the hole thus carefully covered for four or five days. If very warm weather four days will be sufficient, but if colder a longer time will be required. At the end of this time remove the grasshoppers and spread them out in the sun for an hour or two, or until thoroughly dry. Now grind them into a meal. Of this meal, which may be kept dry for a long time until wanted, take two tablespoonfuls and add it to a large tumblerful of water, in which some sugar has been placed. Leave

this in a warm place for from twelve to forty-eight hours, and then treat live grasshoppers by dipping, etc., just as one does when using the fungus when supplied in tubes.

Method of application for migratory grasshoppers.

Take about 1 pound of white bread; dry it and then grate it down into a coarse powder. Put a cupful into a bowl and add enough water to make a watery paste. Add to this the contents of one tube of fungus, and keep it in a warm place until the fungus is seen to be growing over it. Now place small portions where the migratory grasshoppers are appearing, and take care to see that where not eaten the small portions are kept moist from day to day until they have been eaten.

July 17 Mr. Martin wrote:

I have the pleasure of announcing a successful experiment with the locust-disease fungus sent me from the Department. I used it on 60 acres. The weather was very hot and dry and no water to irrigate the land, but to my surprise the fungus took hold and literally covered the ground with dead ones. They are dying, and the disease is still spreading.

At the same time he wrote Prof. Lawrence Bruner, the State entomologist of Nebraska:

I have succeeded in killing a large number of grasshoppers on 60 acres of alfalfa, covering the ground with them for a quarter of a mile. The disease is still spreading, and is now 500 yards from where the infected ones were placed. I do not see why it did not kill all of them. I used corn meal two parts, sugar one part per dose, feeding at 4 p. m., and again 6 p. m., putting them out at 7. The fungus seems to be better a week old than earlier.

Professor Bruner visited the locality and found that several species of native grasshoppers were dying in large numbers. They fell to the ground instead of remaining fastened to the vegetation. Later in the season, however, Professor Bruner writes that other reports were received of dying grasshoppers in localities where no infection had been distributed. A number of these dead grasshoppers were obtained from Mr. Martin, and cultures were made from them in Washington. This work was done by the bacteriological laboratory of the Bureau of Animal Industry, then under the charge of Dr. Victor A. Nörgaard and of late under the charge of Dr. John R. Mohler, and it has been only through the cooperation of these gentlemen that the Division of Entomology has been able to carry on this work. Subcultures have continually been made from these original Colorado specimens, as well as from the first consignment received from South Africa, and another fungus was cultivated from dying grasshoppers obtained in Mississippi late in 1900.

DETAILS OF DISTRIBUTION OF GRASSHOPPER-DISEASE FUNGUS.

During the summer of 1901 grasshoppers were unusually abundant in many parts of the country, and many subcultures of these different lots were sent out. The fungus obtained from Sterling, Colo., was designated as "A," that from Mississippi as "E," and the four consignments from Africa as "B," "C," "D," and "F."

No effort was made to determine the exact nature of the fungus contained in the culture tubes received from South Africa in the spring of 1900, but subsequent events indicate plainly that the Bacteriological Institute at Grahamstown is sending out more than one kind of fungus. From grasshoppers killed in Mr. Martin's first experiments at Sterling, Dr. Mohler isolated and cultivated in the laboratory at the Department of Agriculture a Sporotrichum, and this is the fungus designated as "A." The Mississippi Fungus "E" is, according to Dr. Mohler, *Mucor ramosus*. "B," "C," and "D" of South Africa are Mucors, and "F," also from South Africa, is a Sporotrichum. It thus becomes reasonably certain, since a Sporotrichum has been received from Dr. Edington, that the original culture tubes received in 1900 and cared for by Mr. Martin at Sterling, Colo., contained Sporotrichum. This culture seems to have been the most effective of any which has been tried.

Fungus "A" was sent to Colorado and neighboring States; "E" was sent to Mississippi and neighboring States, and the others were assigned to different States in order to keep a check upon the results. In all, 264 tubes were distributed, and the results as a whole from this distribution do not seem to have been so profitable as to warrant unbounded confidence in this method of fighting injurious grasshoppers. Each person to whom a tube was sent was asked to report the result, and the great majority of them did so. It is fair to assume, however, that in the absence of any report there were no successful results. In some cases, in fact, no trial was made, since the grasshoppers had largely disappeared by the time the fungus was received. The tables following show the name of the locality, the particular culture used, and the number of experimenters (1) in the case of the distributions regarding which no reports have been received or of which no trials were made; (2) in the case of nonsuccess with the grasshopper fungus; and, (3) in the case of reports of success:

Distribution of cultures of grasshopper fungus regarding which no reports have been received or of which no trials were made.

Locality.	Culture.	Number of experimenters.	Locality.	Culture.	Number of experimenters.
Alabama	"F"	1	New Hampshire	"D"	1
California	"D"	5	New Jersey	"F"	1
Colorado	"A"	29	New Mexico	"D" and "A"	23
Cuba	"F"	2	New York	"F"	6
Florida	"F"	1	Pennsylvania	"D"	3
Idaho	"D"	2	Philippine Islands	"A"	1
Illinois	"B"	1	South Dakota	"C"	7
Kansas	"D" and "A"	14	Tennessee	"F"	1
Michigan	"C"	2	Texas	"B"	30
Minnesota	"A"	2	Utah	"D"	18
Mississippi	"B"	2	Wyoming	"C"	3
Missouri	"A"	1			
Nebraska	"C"	13	Total number of experimenters		169

About one-half of these experimenters have not reported. The great majority of the remaining ones were prevented from using the fungus by the fact that they did not receive it until various causes had reduced the number of grasshoppers to the extent that no means of fighting them was necessary. Many of these persons will retain their tubes, and presumably some will be able to send reports next year.

Distribution of cultures of grasshopper fungus regarding which reports of nonsuccess have been received.

Locality.	Culture.	Number of experimenters.	Locality.	Culture.	Number of experimenters.
Colorado	"A"	7	Pennsylvania	"D"	1
Iowa	"F"	1	South Dakota	"C"	1
Kansas	"D" and "A".	1	Texas	"B"	10
Nebraska	"C"	6	Utah	"D"	2
New Mexico	"D" and "A".	5	Wyoming	"C"	2
New York	"F"	1	Total number of experimenters		38
Oklahoma	"B"	1			

Nine of these experimenters report very unfavorable weather throughout the course of the trial; three report favorable weather; two report inability to cause the fungus to grow about the fragments of cork, and two report that the grasshoppers were dying of some local disease at the time of the experiment.

Distribution of cultures of grasshopper fungus regarding which reports of success have been received.

Locality.	Culture.	Number of experimenters.	Locality.	Culture.	Number of experimenters.
Colorado	"A"	2	New Mexico	"D" and "A".	6
Kansas	"D" and "A".	1	Total number of experimenters		16
Nebraska	"C"	7			

SUMMARY.

No trial or no report	169
Unsuccessful	38
Successful	16
Total experimenters	223

ADDITIONAL DETAILS OF SUCCESSFUL EXPERIMENTS WITH GRASSHOPPER-DISEASE FUNGUS.

A little more detail concerning the successful experiments will be of interest.

Mr. E. L. Garrison, of North Platte, Nebr., wrote, under date of July 19, that he followed the directions literally, and although the weather was most unfavorable, being dry and hot, was able to demonstrate that the fungus "is sure death to grasshoppers." They were

found dead in clusters in the shadiest spots under plants and weeds. When he prepared the dead grasshoppers as directed, the fungus promptly developed, and with the meal made from their dead bodies he had really better success than with the culture tube; in fact, it seemed to be more vigorous. He killed bushels of them, and was confident that if the weather conditions were more favorable the grasshopper plague would have been completely stopped.

Mr. Charles H. Toll, jr., of the Denver Sand Company, wrote, under date of September 14, that he had used Fungus "A" according to directions, leaving it thirty-six hours in the water before using. He dipped 100 grasshoppers in the mixture and fed 100 more on white bread soaked with it. These he liberated in two different places, putting them out in rather dry weather. A few days made no impression upon the grasshoppers at all, but on September 12 he visited the places and found some dead ones, but the majority had disappeared. About a quarter of a mile away in an alfalfa field dead grasshoppers were lying quite thickly on the ground. Four miles away another similar alfalfa field was inspected as a check, and while some dead ones were found the proportion was much smaller than in the first field. He concluded that the fungus had killed a good many, although by no means all of the grasshoppers where he first used it.

Mr. S. C. Wills, of Buchanan, Nebr., who used some of Fungus "C," when it was very dry, assures the Entomologist that it killed quite a number, and that they continued to die for some time.

Mr. Samuel E. Shoemaker, of Fruitland, N. Mex., reported, August 26, that the first tube sent (Fungus "D") was prepared, used according to directions, and killed "hundreds of the insects," but only in the damp fields of alfalfa. The preparations made of the dead grasshoppers did little or no good. This failure he attributed to the terrible heat and drought experienced in that section. Another tube, received on July 8, he considered to be a great success, as it seemed to act through the fields where the grasshoppers occurred in enormous numbers and killed thousands. He had no results, however, from the meal of dead grasshoppers.

Mr. G. W. Martin, of Sterling, Colo., found that two tablespoonfuls of ground grasshoppers would make a solution strong enough for 1 gallon of scalded bread, and that amount would go over 160 acres of alfalfa, after which infection would show in thirty-six hours when directions were followed, dead ones being found in five days. Where corn meal was used, infection would show in fifteen hours and dead grasshoppers would be found in two days.

Mr. H. Riekenberg, of Battle Creek, Nebr., dipped grasshoppers on the 14th, 15th, and 16th of June, and turned them loose. He found the first dead ones five days after dipping them. They kept on dying

until the 25th of June, when the mortality seemed to cease. Where he tried the Fungus "C" he considered the grasshoppers to be reduced 50 per cent.

Mr. George E. Allen, of Farmington, N. Mex., spent three weeks in gathering dead grasshoppers and making fungus for neighboring communities according to the directions. He distributed the disease over a territory of 7 miles as a labor of love. The results were said to be excellent, and the disease at one time spread rapidly, the almost complete annihilation of the grasshoppers within a radius of half a mile having been reported. "Millions of the pesky insects" were said to have died within that radius.

CONCLUSION.

It will thus be seen that the present article can be nothing more than a report of progress in an investigation which is being pursued in order to settle the possibilities of a practical use of grasshopper diseases. The results are definite enough to induce still further investigation, which will be carried on during the summer of 1902, but the results obtained so far do not justify very sanguine hopes. The writer is greatly indebted to the correspondents who have assisted him in the course of this work, and promises them and others interested that if there should be anything of practical value in this line of treatment no effort will be spared to conclusively prove it. Prof. Lawrence Bruner was employed by the Department of Agriculture during a portion of the summer to investigate the local outbreaks of grasshoppers in several of the Western States, and was instructed by the writer to pay especial attention to this disease question. In a report which he has submitted he gives as his opinion that the whole matter relative to the killing of insect pests by means of fungous diseases is greatly overestimated, and that this is especially true of their use against destructive grasshoppers. There remains, however, much positive testimony of their value, and the worth of this testimony remains to be thoroughly analyzed. If it is founded upon error in the supposed relation of cause and effect, as were many of the results supposed to have been obtained by the distribution of diseased chinch bugs in Kansas and other parts of the country several years ago, this must be definitely ascertained. One can hardly, however, avoid the conclusion that under favorable conditions some good results from the distribution of grasshopper diseases have been reached.

Persons who have read this article can not fail to realize that it will, in any instance, be unwise to abandon other methods of fighting grasshoppers in favor of the use of this grasshopper fungus. Even if successful in some instances, it is far from being invariably successful. Of course, one can never predict with certainty what the weather will

be, and it seems quite certain that the spread of these diseases depends largely upon weather conditions. The use of the bran-arsenic mash remedy described in the earlier publications of this office, the use of the machines known as hopper-dozers, and such other measures as fall plowing to break up the egg cases, should be followed, the latter in regions where grasshopper attack is at all general, and the others whenever grasshopper swarms make their appearance. This means that every possible method of fighting these destructive insects should be used.

A WORKING PLAN FOR SOUTHERN HARDWOODS, AND ITS RESULTS.

By John Foley,
Field Assistant, Bureau of Forestry.

INTRODUCTION.

One of the greatest strides in the progress of forestry in the United States was made when the Bureau of Forestry undertook, three years ago, "to provide a series of practical examples of improved treatment of private forest lands, in which the present interest of the owner and the protection and improvement of the forest shall have equal weight." Such examples are the best answers to the general question as to how far the private owner may practice forestry. The idea is to assist farmers, lumbermen, and others in the various sections of the country in applying improved methods of handling their forest lands, then to publish the methods and results of the plans likely to be of the most general interest and application.

A typical instance of the examples established by the Bureau of Forestry is found in the preparation and execution of a working plan for conservative lumbering on the tract of The University of the South, at Sewanee, Tenn. This paper is intended to merely review the main considerations in the management of this tract, the broader principles of the working plan, and the principal results. A complete description of the tract and its treatment will be prepared for publication as a bulletin of the Bureau of Forestry.

DESCRIPTION OF THE TRACT AT SEWANEE, TENN.

The University Domain surrounds the town of Sewanee, and comprises 7,255 acres, of which 6,555 are wooded. The remainder of the area is cleared or occupied by buildings. The domain extends over a considerable portion of the Sewanee spur of the Cumberland Plateau, and includes two very distinct types of land; 5,765 acres lie on the rolling table-land of the plateau, while 1,490 acres cover the steep slopes of the coves which cut into it. The elevation varies from 800 to 1,900 feet above sea level. Sandstone and limestone are the principal rocks. The limestone outcrops in the coves up to 1,850 feet, where it is topped by sandstone, the surface rock of the plateau. The soil of the plateau is a loamy sand of poor quality, very loose, and of slight depth. The clay of the coves is of considerable fertility, owing to the admixture with it of limestone.

THE FOREST AT SEWANEE.

The differences in the forest at Sewanee are as marked as those in the topography and soil. The coves are in practically a virgin state. Their slopes are clothed with a fairly dense stand of tall, straight, large-sized trees. Most of these are old, and some of them are so overripe as to be decaying. The important species represented are Black Walnut, Shagbark, Pignut, White Oak, Chestnut Oak, Red Oak, Tulip-tree, Black Cherry, and White Basswood. (Pl. LXV.) The plateau, however, is clothed with an open growth of poor specimens of the inferior species. Occasional large Tulip-trees, Chestnuts, and White Oaks indicate what formerly was there; but at present, owing to indiscriminate cutting, grazing, and repeated fires, the plateau woodland is composed mainly of sprouts and low-crowned trees of good size which have been rejected or overlooked in past lumbering. (Pl. LXVI.)

From this hasty survey of the forest conditions at Sewance it is evident that two very distinct types of forest are represented and that their treatment must be very different. It is this combination of two very common classes of forest land which makes the experiment at Sewanee of especial interest and value. The cove forest corresponds to the tracts of virgin timber which have remained untouched on account of their distance from market or for some other reason. The plateau woodland is typical of the woodlots in the older sections of the country, where the demand for timber has been great and where it has been cut without regard for another crop. The forest in the coves is far from being in as good condition as it might be. The majority of the trees have reached their prime and their growth is very slow. They monopolize room and light needed by younger vigorous specimens. Many of them are of valueless kinds. Such forests require regeneration. It is necessary that the older trees be removed in the proper places and in sufficient numbers to give the small trees of the desirable species a chance to develop. The removal of the undesirable species also prevents their seeding the openings to their own kinds. The aim should be to have in the forest only species of value and none but thriving specimens of these. The treatment of the plateau should have the same object in view. But considerable improvement in the composition of the crop is necessary before this woodland can be said to approach good forest conditions. The larger part of it is composed of crooked, unhealthy sprouts. Many fire-hollowed trees are overtopping young growth. Red Maple, Black Gum, Sourwood, and Mountain Laurel should be got rid of, as they occupy space better occupied by more valuable species.

TREATMENT OF THE FOREST AT SEWANEE.

It is seldom very difficult to determine the treatment necessary to improve the forest. The trouble comes in adjusting these measures

FIG. 1.—VIEW OF COVE FOREST FROM PLATEAU.

FIG. 2.—INTERIOR VIEW OF COVE FOREST.

FIG. 1.—REPEATEDLY BURNED PORTION OF PLATEAU.

FIG. 2.—CUT-OVER AREA ON PLATEAU.

to the wishes of the private owner. He may need a certain amount of money at a certain time, his land may be located where a certain kind of forest produce is of more value than any other, or he may own a mill which he wants to keep going at a certain rate.

In the case under consideration, The University of the South needed money; it wanted as much as it could get, and it did not want to spend any on forest improvements, no matter how profitable they might be in the long run. Thus, a working plan to be acceptable to the university had to provide for good financial returns, and on the other hand, in order to comply with the requirements of the Bureau of Forestry, it had to provide for leaving the forest in better condition than before.

The market for logs, ties, and cordwood is good at Sewanee, and thus was removed one of the greatest and most usual hindrances to the practice of forestry by private owners, namely, the difficulty of selling forest products profitably.

After the value of the timber and the cost of removing it had been thoroughly studied, it was ascertained that by judicious selection of the trees to be cut, so as to favor the reproduction and growth of the desirable species, and by avoiding damage to the small growth and waste in the sawing of timber, it would be possible to improve the character and composition of the Sewanee forest while making it yield a profit to the university. Sawlogs, ties, and firewood are materials through the harvesting of which the improvement of the plateau woodland was to be sought, while sawlogs alone were to be cut in the coves, owing to the higher cost of logging there. No work could be done which would not give sufficient returns to at least pay the expense of the same.

LOGGING THE SEWANEE TRACT.

In accordance with this scheme, enough timber for a year's logging was marked in Hawkins Cove. Tulip-tree, oak, hickory, Cucumber-tree, White Ash, White Elm, and Black Walnut were the species which could be sold. All dead, diseased, overripe, or decrepit specimens of these species which contained enough lumber to repay the cost of removing them were marked for cutting. So were merchantable trees which were suppressing promising young growth. Exceptions to this general rule were made when trees otherwise fit to cut were needed as seed trees, owing to the lack of smaller seed-bearing specimens of their kind. Due consideration was given to the heavy fruit of most of these species, which restricted their seed distribution to the immediate vicinity of the parent tree. The relative demands upon light of the different species influenced the selection considerably, for it would have been useless to leave a Tulip-tree to propagate itself where surrounded by a dense growth of oak and hickory saplings, as the seeds of this species will not germinate except in openings where there is very

little shade. This intolerance of shade is characteristic of Tulip-tree throughout life; it succeeds only when its crown is above those of its companions. This is true in various degrees with other species; some will germinate in shade, but demand sunlight later, others reverse this order. A knowledge of the habits of trees in these respects is therefore very necessary to good results from conservative logging.

On the plateau, trees were marked only where their removal would not expose the already poor, dry soil to the further action of the sun and wind; again, only trees worth more at the time of cutting than they would be in the future were chosen. (Pl. LXVII, fig. 1.) The species favored in the selection of seed trees were Tulip-tree, White Oak, Scarlet Oak, Pignut, and Yellow Oak.

The cutting of logs and ties on the plateau was contracted for under the following rules:

(1) Only marked trees shall be cut.

(2) All marked trees shall be cut, unless a reason satisfactory to the inspector is given for leaving them.

(3) Except in cases of hollow or dote, no stumps higher than 1 foot above the ground shall be cut.

(4) Care shall be taken not to injure young growth while felling, cutting, or hauling the timber.

(5) As much as possible of each tree shall be cut into logs 2 inches longer than the lengths called for by the mill.

(6) The logs cut shall be well butted and hauled to the mill.

(7) Such White and Chestnut Oak trees and parts of trees as will not yield sawlogs shall be cut into as many railroad ties as is possible.

(8) Every effort shall be made to extinguish any fire which may be seen.

In order that the utilization might be as complete as possible and to reduce the amount of combustible material on the ground, the cutting for firewood was to be restricted to the tops of the trees cut on the plateau. The following rules were to govern this work:

(1) No standing trees, living or dead, shall be cut for any purpose whatsoever.

(2) Care shall be taken not to injure any standing trees while cutting and hauling the firewood.

(3) As much as possible of each tree shall be taken.

(4) Such portions of each tree as may be left shall be scattered about, not piled in heaps.

(5) Every effort shall be made to extinguish any fire which may be seen anywhere.

PROTECTION OF THE SEWANEE FOREST.

The insertion of a fire rule in each of the logging contracts indicates the extent to which the working plan concerned itself with this most serious menace to forest preservation and management.

At Sewanee, as in most small Southern communities, the ranging of cattle and hogs in the forest is customary. Since the mat of litter which forms under natural forest conditions prevents the growth of grass and affords a hiding place for nuts, it is burned away by the owners of horses, cows, and hogs, and by gatherers of nuts. The

FIG. 1.—TREE MARKED FOR REMOVAL IN IMPROVEMENT CUTTING.

FIG. 2.—APPEARANCE OF COVE FOREST AFTER LUMBERING.

harm done by the animals themselves through eating and trampling young growth, and by consuming the seed upon which the reproduction of the Chestnut, Pignut, and oaks depend is considerable, but this burning, which is repeated every spring and fall, is disastrous. The humus, the most important factor in soil quality, is destroyed, and the soil thus bared is left to heat, freeze, and dry out to a great depth. Small trees are killed outright. Many of the latter sprout from their roots again, but the new growth is of poor quality and makes slow progress. The large trees are injured at their bases and rot results.

Other causes of fire in the forest at Sewanee are locomotives and careless visitors, but the majority of the fires are set with a view to improving the grazing.

Without a costly patrol, it is almost impossible to prevent fires. The principal hope lies in the realization by the farmers that the practice of burning off the humus is injurious to the land in the long run. In order to prevent the spread of the accidental fires which will occur now and then, the working plan for the University Domain advised the carrying on of work in the woods during the dangerous seasons especially and the adaptation of roads to the uses of fire lines.

A good many trees have been cut every year without the knowledge of the university. Tenants have not confined themselves to their leases, and people from without the tract often appropriate timber to which they have no right. A closer watch by means of a patrol was recommended to guard against this enemy of profitable forest management.

RESULTS OF THE WORKING PLAN AT SEWANEE.

The logging of the tract at Sewanee has been going on since July of last year, and the work, which has been carried on according to the methods above outlined, has been a pronounced success in every way.

The university is perfectly satisfied with the financial returns. It had nothing to do but to contract with a mill man for the purchase of all the marked timber and with a lumberman for getting it to the mill, which the purchaser of the timber found it to his interest to erect at Sewanee. The clear profit to the university, without its having to engage in any of the details of the business, is shown in the following table:

Net returns from logging the University Domain from July, 1900, to May, 1901.[1]

COVE TIMBER.

Grade.	Tulip-tree.	Oak.	Hickory.	Bass-wood.	Black Walnut.	White Ash.	All species.
First grade	$570.98	$124.52	$185.40	$10.46	$10.51	$9.13	$911.00
Second grade	214.55	33.07	18.16	4.54	13.67	25.11	309.10
Third grade	19.58	....	....	....	2.38	10.58	32.54
All grades	805.11	157.59	203.56	15.00	26.56	44.82	1,252.64

[1] At least three months' work remains to be done.

Net returns from logging the University Domain from July, 1900, to May, 1901—Cont'd.

PLATEAU TIMBER.

Grade.	Tulip-tree.	Oak.	Hickory.	Bass-wood.	Black Walnut.	White Ash.	All species.
First grade	....	....	$1.40	....	....	....	$1.40
Second grade	$39.69	$13.83	.27	....	....	....	53.79
Third grade	6.78	....	....	....	....	....	6.78
All grades	46.47	13.83	1.67	....	....	....	61.97

ALL GRADES.

Grade.	Tulip-tree.	Oak.	Hickory.	Bass-wood.	Black Walnut.	White Ash.	All species.
Cove	$805.11	$157.59	$203.56	$15.00	$26.56	$44.82	$1,252.64
Plateau	46.47	13.83	1.67	....	....	....	61.97
Total	851.58	171.42	205.23	15.00	26.56	44.82	1,314.61

The lumberman, like nearly all lumbermen, at first looked askance at the rules to govern his work and raised his price for the job, because he felt sure these rules would increase his expenses; but he was agreeably surprised at the results. He and his crews found that the required stump height was not a trying one to adhere to, and that the satisfaction of putting the trees where they wanted them and leaving the woods in presentable condition more than made up for the little time and trouble required to fell trees away from young growth. That he found his profits in no wise curtailed may be taken for granted from the fact that he is anxious to get the contract for the next year's logging, and that his bid for the work is comparatively lower than for his first work.

The Bureau of Forestry is satisfied because it has demonstrated that a happy medium between forestry and lumbering can be struck. Had the University Domain been logged as it would have been ordinarily, the money returns would have been no greater. The chances are that they would have been less, for the little or no care taken in felling would have resulted in waste due to many shattered, splintered trees.

The condition of the forest after lumbering is the principal concern of the Bureau of Foresty. The present state of the logged area at Sewanee is all that was expected. The contractor followed his instructions carefully, with the good result of cutting only the proper trees and reducing damage to young growth to a minimum.

The consequence is that to-day there are plenty of vigorous small trees in Hawkins Cove given a new lease of life owing to increased light and growing space. (Pl. LXVII, fig. 2.) Reproduction of the best kind has taken place, even Tulip-tree, White Ash, and White Elm being found along the logging roads and skidding paths.

FLOODS AND FLOOD WARNINGS.

By H. C. Frankenfield,
Forecast Official, Weather Bureau.

FACTORS IN THE VOLUME, EXTENT, AND DURATION OF A FLOOD.

The volume, extent, and duration of a flood in any particular river must, of course, depend primarily upon the precipitation contributory to the flood over the river's drainage basin or watershed. First, the total amount of precipitation must be considered; then the distribution, whether general or local; the character, whether rain or snow; the rate of fall; and finally the duration. If the first flood requisite, an excessive water supply, be fulfilled, the influence of the remaining factors must be determined before any definite knowledge can be had of the coming flood tide. Upon the predominance of any one or more of these factors will depend the characteristics of the flood. If all are prominent to a marked degree (fortunately an extremely rare occurrence) the flood will be of excessive and dangerous proportions; if only one or two factors are largely present, and the others but moderately so (and this is the usual condition of affairs), the flood proportions will be lessened. Differing combinations will cause widely differing effects, the character of these effects depending upon the intensity and variety of the conditions contributing to the flood.

COMPLICATIONS IN THE STUDY OF FLOODS.

In a study of floods, the complications, which are many and varied, begin to appear after the question of precipitation is disposed of. One of these complications is the topography of the country, whether precipitous or gently sloping; whether covered by forests and dense foliage, or comparatively bare; and if bare, whether cultivated or uncultivated. The run-off would be less rapid in a gently sloping country than in a precipitous one, and less rapid also in regions well covered by vegetation and forests. Cultivated soil, owing to its looser texture, will naturally absorb more water than that which is uncultivated, and thereby diminish the run-off. Another complication is the extremely important one of the character and condition of the soil, whether rocky, clayey, or sandy; whether frozen or not, and whether dry or moist. Very little water would be lost by absorption in a rocky country, more in a clayey one, and much more in a sandy one. Frozen earth would admit of a rapid run-off, with but little loss, while an unfrozen surface would permit some absorption, whether much or

little depending upon its condition. If there had recently been but little precipitation, a considerable quantity of water would be absorbed; if much rain had fallen, the ground would have already been quite saturated, and not in a condition to absorb any more water.

In the winter and early spring the temperature is a very important factor. If a heavy rain has fallen and general conditions indicate a flood, a decided fall in the temperature will usually freeze the tributaries and check the outflow of water. On the other hand, if the watershed is well covered with snow, and heavy rain sets in, accompanied by thawing temperature, the snow will melt rapidly and add its volume to that of the rain, greatly augmenting the flood height. This is the condition most feared and oftenest met with in mountainous streams where the run-off is exceedingly rapid, owing to the precipitous and rocky character of the country.

Over the watersheds of the extreme north, where the temperatures as a rule remain considerably below the freezing point during the entire winter, a sudden spring thaw will cause a rapid melting of the snow, and consequently a moderate flood wave in the rivers. Snow of itself, however, in such quantities as fall in this country will not produce a dangerous or destructive flood. It is only when combined with rain that it becomes a subject of apprehension.

FEATURES OF ATLANTIC SYSTEM OF RIVERS AND MISSISSIPPI RIVER SYSTEM.

The floods of the Atlantic system of rivers, as might be expected from the geological and topographical character of their watersheds, are limited in extent, of very rapid creation, and of equally rapid subsidence, until the waters cross the "fall line" into the Coastal Plain. When this plain is reached the slope toward the sea is much more gradual, the river banks much lower, and the flow of water greatly retarded. The floods then partake of the character of those of the Lower Mississippi system, reaching at times to dangerous heights, yet rising at such a slow rate as to sorely tax the nerves of the waiting and anxious dwellers in the bottom lands. The subsidence is equally slow.

The greatest floods of our history have been those of the Mississippi River system, particularly those of the Ohio and that portion of the Mississippi below the mouth of the Ohio. The total drainage area of the Mississippi River is 1,240,039 square miles (about two-fifths of the total area of continental United States), of which 527,155 square miles, or about 42½ per cent, belong to the Missouri basin, and 201,720 square miles, or about 16 per cent, to the Ohio basin. But as the Missouri watershed is not so highly favored with precipitation as are those of the Ohio and Mississippi, particularly of the Lower Mississippi, its great preponderance of territory avails but little when its

precipitation is compared with the abundant rainfall of the Ohio and Mississippi valleys.

The normal discharge of the Missouri River, according to Morrill, is 15 per cent of the total precipitation; that of the Upper Mississippi, 27.5 per cent; that of the Ohio, 30 per cent; that of the Arkansas, 15.6 per cent; that of the Red, 22 per cent; that of the Lower Mississippi Valley, 51.5 per cent, and that of the entire Mississippi basin, 25 per cent. Or, to state the facts in another way, out of a normal annual precipation for the entire basin of about 30 inches, 25 per cent, or 7.5 inches, would find its way into the Gulf of Mexico, no allowance being made for evaporation or overflow. Of this average of 7.5 inches for the entire basin, the Missouri would have contributed 0.7 of an inch, the Upper Mississippi 1.1 inches, the Ohio 1.5 inches, the Arkansas 1 inch, the Red 1.3 inches, and the Lower Mississippi Valley 1.9 inches. These figures easily demonstrate the absolute incapacity of the Missouri River as a flood producer below the mouth of the Ohio. This can be brought out still more clearly by giving the amount of water which each basin annually contributes to the total which finally reaches the Gulf of Mexico, the loss by evaporation and overflow being neglected. The figures in millions of cubic yards, as given by Morrill,[1] are as follows: Missouri, 131,990; Upper Mississippi, 125,230; Ohio, 230,130; Arkansas, 74,070; Red, 66,670; Lower Mississippi Valley, 157,100—a total of 785,190,000,000. For convenience of inspection and reference, the above figures are grouped together in the following table:

Percentage run-off and annual discharge of Mississippi River system.

Basin.	Run-off.	Proportionate distribution of run-off.	Annual discharge.
	Per cent.	*Inches.*	*Millions of cubic yards.*
Missouri	15.0	0.7	131,990
Upper Mississippi	27.5	1.1	125,230
Ohio	30.0	1.5	230,130
Arkansas	15.6	1.0	74,070
Red	22.0	1.3	66,670
Lower Mississippi Valley	51.5	1.9	157,100
Total	....	7.5	785,190

It must not be assumed, however, that the Missouri and Upper Mississippi rivers have no effect upon the lower river. While it is true that in themselves they are incapable of causing a flood below the mouth of the Ohio, they can, nevertheless, when only at comparatively high stages, cause a marked increase in a flood crest which is already

[1] Floods of the Mississippi River.

there, and accordingly prolong its duration. It can also happen, if the lower river were near the flood stage, without any likelihood of reaching it with its own water supply, that a comparatively small contribution from above would turn the tide upward to the critical and possibly to the dangerous point.

THE GREAT FLOODS OF THE COUNTRY.

The great floods of this country of which there are authentic records all occurred during the nineteenth century. Of those previous to the year 1798, nothing is known except by tradition. If these more or less legendary records are to be accounted trustworthy, the flood of April, 1785, in the Upper Mississippi and Lower Missouri rivers has not been since equaled, the great flood of 1844 ranking next in order. The floods since 1789 of which we have reliable data were those of 1815, 1828, 1844, 1849, 1850, 1851, 1858, 1859, 1862, 1865, 1867, 1874, 1881, 1882, 1884, 1890, 1892, 1893, and 1897. The greatest flood of the Lower Missouri and Upper Mississippi rivers, if that of 1785 be not considered, was that of June, 1844, when the Mississippi River at St. Louis reached a stage of 41.4 feet on June 27, and the Missouri at Kansas City a stage of 37 feet on the 20th of that month. During this flood the Illinois and Mississippi rivers united between Hardin and Grafton, Ill., covering a distance of about 10 miles at the widest part, and formed one continuous river. The Missouri River spring flood of 1881 was also of extensive character. The greatest flood of the Ohio River was that of February, 1884, when on the 14th day of the month the water at Cincinnati reached a crest stage of 71.1 feet. In the Lower Mississippi the greatest flood was the recent one of the spring of 1897. This flood, although not of extreme duration, was made famous by reason of the unprecedented high stages between Memphis and the mouth of the river, the excess above the greatest previous known stages ranging from 0.6 foot at Vicksburg, Miss., to 3.7 feet at Helena, Ark.

Tremendous as they sometimes are, the floods of the Lower Mississippi have never been as extensive as was possible for them to have been. Should all the rivers happen to be in flood at the same time, the total discharge would be about 3,000,000 cubic feet of water a second, about 33⅓ per cent greater than has ever been known.

CONDITIONS WHICH WOULD PRODUCE AN UNUSUAL FLOOD.

In the floods of the past thirty years the western tributaries have not played a very important part. By far the greater portion of the water has come from the Ohio and Lower Mississippi rivers. In the flood of 1897 neither the Missouri, the Platte, nor the Arkansas river contributed any considerable amount of water to the main flood, by far the major portion coming from the eastward tributaries. A glance

at the weather maps of the flood periods will show the reason for this state of affairs. The heavy rains of the Ohio and the Middle and Lower Mississippi valleys are usually caused by what are known as "southwestern storms," which move up from Mexico, or the Southern Plateau, eastward over Texas, and thence northeastward over the Ohio Valley, or else eastward to the South Atlantic States, and thence northward along the coast. The influence of these storms, which are always accompanied by heavy rain, does not extend north of the Lower Arkansas Valley, and, consequently, but little rain falls from that district northward. On the other hand, the storms that cause heavy rains over the Northwest and the Central West do not extend their influence very far to the southward, and but little rain therefore falls over the Ohio and Lower Mississippi valleys. It must also be noted that this type of storm is not attended by as heavy precipitation as is the former, the average amount being less than one-half. The ideal type for a flood of greater proportions than ever before known would be a combination of the two in the early spring, with heavy unmelted winter snows over the northern watersheds. The melting snow would then become an important factor in increasing the height of the northern flood wave.

Should such a misfortune as this ideal storm ever come to pass, the order of the different flood waves would probably be as follows: First, the Arkansas, the Red, and the White; then the Upper Mississippi; then the Missouri. In the meantime the Lower Mississippi would already be at moderate flood stage, and with each succeeding contributory increment would rise higher and higher, until all levees were either overflowed or washed away, and many thousands of square miles of plantation lands inundated.

EARLY MEASURES FOR PROTECTION AND CONSTRUCTION OF LEVEES.

As the floods came in the past, and as they will continue to come in the future, without hope of prevention or even diminution; methods of partial escape from their devastations had to be devised, and when once entered upon kept at the highest possible state of efficiency. In early days when a flood came the inhabitants in the bottoms simply moved their stock and other portable property to higher ground, and waited for the waters to recede. This custom was exceedingly expensive and vexatious, and frequently prevented the planting of crops. As the population increased the losses also increased, and it became imperatively necessary to devise preventive measures. The most effective method was, of course, to put up something that would keep the water out, and therefore earthworks, or "levees," as they are called, were constructed. A few of the more enterprising landowners began to build private levees around or in front of their lands. These were effective as far as they went, but sooner or later there would come

a flood of greater proportions than usual, and away would go the levee. A few experiences of this character demonstrated the need of concerted action, and then levees were built, first by separate communities, and afterwards by the States, the necessary funds having been raised by taxation of the persons affected. The General Government assisted from time to time in later years, beginning with $1,300,000 in 1882, the first appropriations, however, being made solely for repairs at places where improvements of the channel were necessary for purposes of navigation. It was not until the year 1891 that the General Government made its first unconditional contribution to the cause in the shape of an appropriation of $1,000,000 to repair the ravages of the overflow of the preceding year.

The first levee was 1 mile in length and was built at New Orleans in 1717 to protect the high lands along the banks of the river. It was only 4 feet in height. During the succeeding years levees were slowly extended, until about 1735 they extended along both banks of the river, from 12 miles below to 30 miles above New Orleans. These levees protected the higher lands immediately along the banks of the river, and flood waters were allowed to overflow the valleys without restraint. It was not long, however, before the extreme richness of these alluvial valley lands began to attract a larger population, and with them came the necessity for protection against overflow. The work of levee building was therefore pursued unremittingly, until by the year 1858 almost the whole lower basin had been leveed. The neglect and ravages occasioned by the civil war destroyed the greater portion of the work, but after the war had ended it was again taken up with renewed energy, until at the present time there are approximately 1,800 miles of magnificent levees below the mouth of the Ohio River.[1]

Above the mouth of the Ohio there are some levees of lesser extent, the best and most widely known being the Warsaw and Sny levees, which extend from Warsaw to Hamburg, Ill., a distance of about 110 miles, affording protection to about 387 square miles of the finest farm lands in the world. These levees are now of such strength and dimensions that they would withstand a flood as high as has ever been known, and in many places an additional foot or two. There are also levees of lesser character in the South Atlantic States, particularly in South Carolina after the rivers cross the "fall line" into the comparatively level Coastal Plain, and in the Sacramento Valley of California.

[1] For the historical and statistical matter in the paragraph on levees, the writer is indebted to the work of Mr. Frank H. Tompkins, on "Riparian lands of the Mississippi."

GOVERNMENT WORK IN FORECASTING RIVER STAGES.

THE SIGNAL SERVICE SYSTEM.

Previous to the organization of the meteorological branch of the Signal Service in 1871, no systematic and concerted efforts had ever been made to obtain advance information of the coming of floods. Individual attempts were made by different communities and interests with fairly satisfactory results, considering their extremely limited facilities, the measure of success depending upon the extent, reliability, and timeliness of the information received. But it was not until the year 1871 that the influential commercial bodies of the great river valleys made a request that the stages of the water at the Signal Service stations along the rivers be embodied in the regular telegraphic bulletin issued each day. This service began on January 1, 1872, and for the first time a portion of the energy of the Signal Service was directed toward the investigation of "the great problem of the protection of the river commerce from ice and freshets, and also of the river levees from breakage and overflow, with the consequent disasters." The importance of the new service was fully recognized, and its success, in a general way at least, was assured from the outset. Its benefits were not limited to the forecasting of floods alone; the daily changes, often very slight in themselves, were given, and these were of equal benefit. It was essential to the most economic handling of the vast river commerce that the daily fluctuations in the river levels be known in order that boats might be loaded accordingly, and that they might arrive safely at their destinations. For such purposes as this the knowledge of coming low-water stages is fully as important as that of the coming of high water.

In 1872–1873 no attempts at forecasting the coming stages were made. These were begun in 1874 and were rather perfunctory in character, limited to the simple expressions that "the rivers will rise;" "the rivers will fall;" "the Ohio and Tennessee will rise and the Mississippi and Missouri will remain stationary." The elaboration of these forecasts, which was necessary in order to make them of any definite value was left unintentionally, but none the less effectively, to the local officials in charge of the various stations.

With succeeding years the service was steadily extended, the number of reporting stations increased to meet growing demands, its field of usefulness broadened, and, what is much more to the point, the accuracy and localization of the forecasts vastly improved.

THE PRESENT WEATHER BUREAU SYSTEM.

Previous to July 1, 1893, the work of river forecasting had been performed entirely at the central office of the Weather Bureau at Washington. On that day, however, the work was delegated to the

various local forecast officials of the Weather Bureau, under the general supervision of the central office. To each official in charge of a river district there was assigned a certain territory around which were grouped a sufficient number of substations, both river and rainfall, and he was thereafter held responsible for the river work of his district. The change proved to be an advantageous one in every respect. Each official, having but a comparatively limited territory, was enabled to make a thorough study of all conditions affecting its rivers and their watersheds. Forecasts could be and were made for any individual locality, however small. The following table shows the river districts of the United States, with the number of river and rainfall stations assigned to each:

River districts and river and rainfall stations.

River district.	River stations.		Rainfall stations.		River district.	River stations.		Rainfall stations.	
	Regular.	Special.	Regular.	Special.		Regular.	Special.	Regular.	Special.
Albany, N. Y	0	0	0	0	Mobile, Ala	3	1	1	0
Atlanta, Ga	5	0	0	0	Montgomery, Ala	7	0	8	0
Augusta, Ga	2	0	3	0	Nashville, Tenn	3	0	1	0
Cairo, Ill	5	2	1	1	New Orleans, La	4	2	0	0
Charleston, S. C	8	0	2	0	Omaha, Nebr	2	0	0	0
Chattanooga, Tenn	5	2	7	0	Parkersburg, W. Va	4	0	2	0
Cincinnati, Ohio	9	3	1	1	Pittsburg, Pa	19	3	0	0
Davenport, Iowa	2	0	0	0	Portland, Oregon	5	3	0	0
Dubuque, Iowa	0	0	0	0	Raleigh, N. C	4	0	3	0
Fort Smith, Ark	1	0	2	0	Richmond, Va	0	2	0	3
Galveston, Tex	3	9	0	0	St. Louis, Mo	7	0	1	0
Harrisburg, Pa	4	1	0	0	St. Paul, Minn	0	0	1	0
Kansas City, Mo	1	0	1	0	San Francisco, Cal	0	10	0	8
Keokuk, Iowa	0	1	0	0	Shreveport, La	2	0	0	0
La Crosse, Wis	3	2	0	0	Vicksburg, Miss	3	0	1	0
Little Rock, Ark	2	0	1	0	Washington, D. C	3	0	1	0
Louisville, Ky	3	0	0	0	Total	122	41	37	13
Macon, Ga	1	0	0	0					
Memphis, Tenn	2	0	0	0					

In addition to the substations, river observations are also taken at 42 regular stations of the Weather Bureau, principally, of course, at the district centers.

The forecasts are adjusted to the peculiar conditions of each separate locality, long experience having demonstrated the needs of each particular one.

Along the great navigable rivers, as the Mississippi, the Ohio, the Tennessee, the Cumberland, the Alabama, and the Red, river forecasts are made daily throughout the year in the interests of navigation. On others, forecasts are made in times of flood and of abnormally low water, and at others only in times of flood.

Under the district system, the accuracy and timeliness of the river

forecasts were vastly improved, and at present it is a very common occurrence to have the crests of great floods correctly forecast to within 1 foot and at times to within fractions of 1 foot. In the swift-running mountainous streams it is frequently impossible to make a forecast for more than twenty-four hours in advance, but in the slower moving rivers, such as the Missouri, the Mississippi, and the Lower Ohio, they can be made accurately four or more days in advance. In the Missouri and the Upper Mississippi, below Dubuque, the flood stage can be forecast to within 1 foot or closer at least three days in advance, while in the Lower Mississippi equally accurate forecasts can be made for periods ranging from ten to fifteen days in advance. For those specially interested, a reference to the work of the Weather Bureau during the great flood of 1897 will afford an excellent example of the remarkable exactness of these warnings. They were, in fact, so complete and far-reaching as to excite the criticism that the Weather Bureau was creating unnecessary alarm in the minds of the people of the threatened districts. Subsequent developments, however, proved them to have been fully justified.

The river and flood work of the Weather Bureau along navigable rivers is now so interwoven with the various business interests affected thereby that it practically amounts to a portion of their capital stock, or assets. In the days when river forecasts were unknown, steamboats were run and freight shipped with no certainty of arrival at destination within a reasonable time. At the present time the stages at various places along each river are known, together with the prospects of rise or fall. No risks are run and there are no costly delays.

Efforts are being constantly made to still further improve this valuable branch of the public service by more searching investigation and judicious expansion. On some of the navigable rivers, particularly the Mississippi, changes in the beds and banks, both natural and artificial, operate constantly to alter the gage relations between different places. These changing conditions, whose effect must be largely anticipated, require continuous observation and study in order that variations in the flood relations, as well as those of low water, may be accurately computed. Another subject for constant investigation is the change attributable to the cultivation of the soil, such as increase or decrease of acreage and the character of the crops. Still others are the questions of the effects of swamp drainage, the gradual cutting away of forests, the introduction of subsoil drainage, etc. An intelligent comprehension of each condition and its cause is absolutely essential to accurate work, and the skill and success of the forecaster will depend entirely upon the amount of ability and energy that he brings to bear upon the subject.

As to the matter of expansion, it may be added that since the close of the year the new river district of Knoxville, Tenn., has been created

with nine substations under its jurisdiction, five of them being river and four rainfall stations. This district was created by the chief of the Weather Bureau in compliance with a strong demand from the people of that section for special river and flood service, and similar demands are constantly being received from other sections of the country. In fact, the demands of the public for information concerning the rivers are persistently increasing, an evidence of the efficiency and popularity of the service. Its cost is insignificant, a few thousand dollars a year, while its direct benefit to the commercial and agricultural interests can be measured only in millions of dollars.

PROGRESS OF THE BEET-SUGAR INDUSTRY IN THE UNITED STATES.

By Charles F. Saylor,
Special Agent and Investigator.

INTRODUCTION.

The production of sugar beets and of beet sugar in the United States is now assuming such proportions that, with the increase of factories and the marked popular interest, it has become one of the leading subjects demanding consideration from agriculturists. There is probably no other industry in this country that has developed so rapidly and now absorbs so large a share of public attention as that of beet sugar.

FIRST ATTEMPTS TO START THE BEET-SUGAR INDUSTRY.

Attempts were made to establish the beet-sugar industry in Massachusetts some sixty-two years ago. There were also efforts in this direction in Illinois, Wisconsin, and California between the years 1863 and 1876, and much was claimed for the industry at this time by newspaper writers, capitalists, and leading farmers. In California, after a long period of unprofitable production, the industry achieved its first success. The failure of these early attempts seems now very natural as we look back over the history of agricultural progress in the United States. The beet-sugar industry belongs to the domain of agriculture, and the problems it presents are agricultural. These early efforts were simply ahead of their time in the course of agricultural development, and they failed in the establishment of the beet-sugar industry for want of the proper methods of farming and the proper conditions underlying the farming industry.

DEVELOPMENT OF FAVORABLE CONDITIONS FOR BEET-SUGAR INDUSTRY.

At the time of the first attempts at sugar-beet production agriculture comprehended simply the primary features. Its products were confined mainly to cereals, forage crops, and live stock, and the production and marketing of raw materials was its main object. The farmer in those early days did not concern himself with enterprises dependent on the concentration of efforts in the production of finished products. Land could be purchased for a few dollars per acre. If

the prospective farmer did not have the money to buy land he could enter a claim on Government land. His whole ambition was to produce something quickly and pay for the lands and primary improvements. This was accomplished by raising corn, wheat, oats, cattle, and hogs. The open public domain offered a free pasture. Gradually the Eastern sections became more densely settled, and farm lands became more expensive. Crude production was accomplished more cheaply by the Western farmer. Later, owing to development of transportation facilities, the agriculture of this country had to compete with the cheap labor of Europe. The colonial extension of European countries brought areas into competition with American farms in turning out crude products, and with labor much cheaper even than that of Europe. The problem became, how to turn crude material into something that would represent not merely the labor but the skill and ingenuity of the American people, thus supplying our own markets and those of the world with finished products. The American farmers found, as the manufacturers had found before them, that their success depended upon the superior skill and artisan ability of Americans as compared with Europeans and their colonists. "Necessity is the mother of invention," and demand and necessity united in the evolution of a new system. This began in the East, working westward, in the production of butter, cheese, prepared meats, flour, eggs, poultry, etc. Later came the establishment of other industries, working up crude products of the farm into finished articles. We became producers of sirups, canned vegetables, canned fruits, etc., until manufacturing reenforced farming from ocean to ocean. When all this was accomplished the time was ripe for the success of the beet-sugar industry.

INDUSTRIAL FEATURES OF THE UNITED STATES.

It is one of the marked features of American industrial life that the people as a mass have always shown a readiness to forego immediate benefits and, even at considerable expense to themselves, to encourage industrial development. As a result, this country has made a record among the nations of the earth unparalleled in rapid development, accumulation of wealth, and hold on the trade of the world.

One of the chief items of cost in the production of anything is labor. In this country it is contended that the laborer is not only entitled to earn a living, but to live comfortably, to be able to educate his family, and to acquire a comfortable home. There is no position in life, social, financial, or political, to which the laboring man may not aspire. While this means much for the citizen, it adds materially to the cost of production. This country to-day is the concern of the nations of the earth in being able to maintain a balance of trade in its

favor through its agricultural and industrial productions, and this balance is constantly increasing. The sugar industry is supported by American enterprise and spirit, and under this American policy it is rapidly assuming a prominent position in the long list of successful industries.

PROBLEMS FOR THE FARMER IN GROWING SUGAR BEETS.

There are two sides to the proposition of establishing a sugar factory in any particular community: (1) That of the farmer, involving agricultural conditions, and (2) that of the manufacturer or those financially interested in the enterprise.

METHODS EMPLOYED IN GROWING SUGAR BEETS.

The leading difficulties of the farmer may first be noticed. To begin with, he is unacquainted with the methods of cultivating the sugar-beet plant, and his first experience usually proves unsatisfactory. He is accustomed to certain methods in farming. As a rule, he is conservative, and thinks, from his long experience in farming, that he knows how to farm. He undertakes to apply methods successful in the cultivation and production of other crops. He is not inclined to listen to those who are posted in methods applicable to the new crop. Eventually he finds out his mistake. He finds that in growing sugar beets he must apply principles, in many cases, the reverse of those necessary to other crops. For instance, he has been accustomed to growing large ears of corn, large hogs, and large steers; but in the case of sugar beets he finds that the first question is not one of size, but of quality. He must grow beets of a certain size, purity, and sugar content. In order to accomplish this he must give careful attention to the work of preparing the land, planting the seed, bunching, thinning, and cultivating. He finds that attention to details counts in results at the harvest in the profits on the crop. He learns that the whole process is a very laborious and expensive one, entirely unlike anything he has attempted before. To be successful he must apply the methods of the gardener to a field crop. He must have a rich soil and the proper rain conditions at the proper time. These facts can only be learned through experience.

THE QUESTION OF LABOR.

The labor problem is important in the cultivation of sugar beets. At certain stages of their growth sugar beets require a considerable amount of labor. This labor is very tiresome. As a rule, the farmer, if he grows beets to any extent, does not have on his farm sufficient labor to do the work of thinning and bunching, hoeing, and harvesting the sugar beets; nor does any farming community possess to any

considerable extent the labor necessary to grow the beets that a factory will require in a campaign. It will cost about $30 an acre in sections where sugar beets are grown under rainy conditions, and about $40 to $45 an acre in sections where beets are grown by irrigation, to cover the cost of seed, preparation of seed bed, bunching and thinning, hoeing, cultivating, harvesting, and delivering to the factory. These estimates apply to growing sugar beets when it is properly done. In the farming communities of foreign countries, as a rule, a large amount of suitable labor can be secured in the neighborhood, because these neighborhoods are more thickly settled; the whole population is willing to do the laborious, tedious work required, and whole families work at it, including the father, mother, and children. In this country, as a rule, the farmer, his older sons, and hired hands must attend to the outdoor work. It has been found necessary for sugar-beet growers to resort to the cities and towns for the extra labor required. Most of this work comes about the time the public schools are closed, and boys from 12 years up are employed for bunching and thinning the beets, for hoeing them during the season, and to aid in the harvesting by pulling, cleaving the tops, and loading the beets into wagons. In the cities also live many foreigners from Holland, Russia, Sweden, and other places who are thoroughly familiar with this kind of work. These people are willing to move out into the fields and live in tents; they make contracts at so much per acre for bunching and thinning, hoeing, weeding, and harvesting. Since the agitation and starting of the beet-sugar industry in this country foreigners are coming here with a view to securing employment of this kind. While the labor question is a serious one, it is one capable of solution by careful and detailed attention.

PROBLEMS FOR THE MANUFACTURER IN THE BEET-SUGAR INDUSTRY.

The manufacturer or the capitalist who builds a factory finds that he has even more problems to work out than the farmer, and, like the farmer, he usually discovers that he is entering a field that is entirely new to him. Before establishing his plant the prospective manufacturer must thoroughly investigate certain conditions: (1) The water supply for he must have an abundant supply of pure water for the use of the factory. (2) The fuel supply, as the factory must be located in a section where cheap fuel can be secured (the fuel usually used is coal, but on the Pacific coast petroleum is used to a large extent, and in some of the mountain States it is found that wood is the cheapest fuel). (3) A market for the product (this factor should be thoroughly canvassed and settled prior to establishing a factory; the fact that the manufacturer is proposing to establish a factory on a particular line of railroad can generally be used to secure by contract

low freight rates for the future both in shipping beets and the finished product—sugar). (4) The supply of lime (the local quarries of lime rock must be investigated to see if the quality is suitable and the supply sufficient, as a large amount will be required).

The general conditions having been found satisfactory, and the factory being built, other problems arise. In the beginning only a limited amount of skilled labor is employed. Eventually every employee of the factory will become skilled in his particular part. After two or three campaigns have passed the factory will have worked out the details of producing the best product at the least cost with the machinery which it has. When this point shall have been reached those interested will be prepared to estimate the cost of production of beet sugar. The difference in cost of production at a new factory and at one operated for a considerable time is much greater than one unacquainted with the subject would suppose.

STATISTICS OF GROWTH OF THE BEET-SUGAR INDUSTRY.

The recent census shows the rapid growth of the beet-sugar industry in this country. Thirty-one factories had been established before the end of the century. Since that time 11 other factories have been put in operation, located at the following places and having the daily capacities named: Lyons, N. Y., 600 tons; Rockyford, Colo., 1,000 tons; Sugar City, Colo., 500 tons; Bingham Junction, Utah, 350 tons; Provo, Utah, 350 tons; Lansing, Mich., 600 tons; Saginaw, Mich., 600 tons; Salzburg, Mich., 400 tons; Loveland, Colo., 1,000 tons; Menomonee Falls, Wis., 500 tons, and Logan, Utah, 400 tons. Pls. LXVIII–LXXI show the present methods of handling sugar beets, as well as a representative factory.

At the following places factories are either in process of erection or preparations have been made for building in 1902: Sebewaing, Mich., 600 tons; Carrollton, Mich., 600 tons; Mount Clemens, Mich., 600 tons; Croswell, Mich., 600 tons; Greeley, Colo., 800 tons; Eaton, Colo., 500 tons; Fort Collins, Colo., 500 tons.

At the following places companies have been organized and capitalized, and there is every indication that they will mature their plans and erect factories in time to engage in the beet-sugar campaign of 1902 or 1903: Saginaw, Mich., two factories, 500 tons each; Chesaning, Mich.; Badaxe, Mich.; Grand Rapids, Mich.; Lapeer, Mich.; Sioux City, Iowa; Longmont, Colo.; Lamar, Colo.; Bear River Valley, Utah; Phoenix, Ariz.; Cheyenne, Wyo.; Los Angeles, Cal.

At many other places preliminary organizations have been formed which are only awaiting developments assuring more settled conditions affecting the sugar industry.

The following table shows the States that are already producing beet sugar, and the locations and capacities of the factories therein:

Beet-sugar factories of the United States.

Name of company.	Location of factory.	Daily capacity in tons of beets.
MICHIGAN.		
Michigan Sugar Co	Bay City	500
Bay City Sugar Co	Bay City	600
Detroit Sugar Co	Rochester	500
Wolverine Sugar Co	Benton Harbor	350
Peninsular Sugar Refining Co	Caro	600
West Bay City Sugar Co	West Bay City	750
Alma Sugar Co	Alma	600
Holland Sugar Co	Holland	350
Kalamazoo Sugar Co	Kalamazoo	500
Marine Sugar Co	Marine City	350
Lansing Sugar Co	Lansing	600
Saginaw Sugar Co	Saginaw	600
German-American Cooperative Beet Sugar Co	Salzburg	400
Sebewaing Sugar Co	Sebewaing	600
Valley Sugar Co	Carrollton	600
Macomb Sugar Co	Mount Clemens	600
NEW YORK.		
Binghamton Beet Sugar Co	Binghamton	600
Empire State Sugar Co	Lyons	600
COLORADO.		
American Beet Sugar Co	Rockyford	1,000
Colorado Sugar Manufacturing Co	Grand Junction	350
National Sugar Manufacturing Co	Sugar City	500
Western Construction Co	Loveland	1,000
Greeley Sugar Co	Greeley	800
UTAH.		
Ogden Sugar Co	Ogden	350
Utah Sugar Co	Lehi	350
Utah Sugar Co. (Rasping Station)	Springville	350
Utah Sugar Co. (Rasping Station)	Bingham Junction	350
Utah Sugar Co. (Rasping Station)	Provo	350
Logan Sugar Co	Logan	400
NEBRASKA.		
American Beet Sugar Co	Grand Island	350
American Beet Sugar Co	Norfolk	350
Standard Beet Sugar Co	Leavitt	500
CALIFORNIA.		
Alameda Sugar Co	Alvarado	800
Spreckels Sugar Co	Watsonville	1,000
Los Alamitos Sugar Co	Los Alamitos	700
American Beet Sugar Co	Chino	1,000
California Beet Sugar and Refining Co	Crockett	1,200
Spreckels Sugar Co	Spreckels	3,000
American Beet Sugar Co	Oxnard	2,000
Union Sugar Co	Betteravia	500

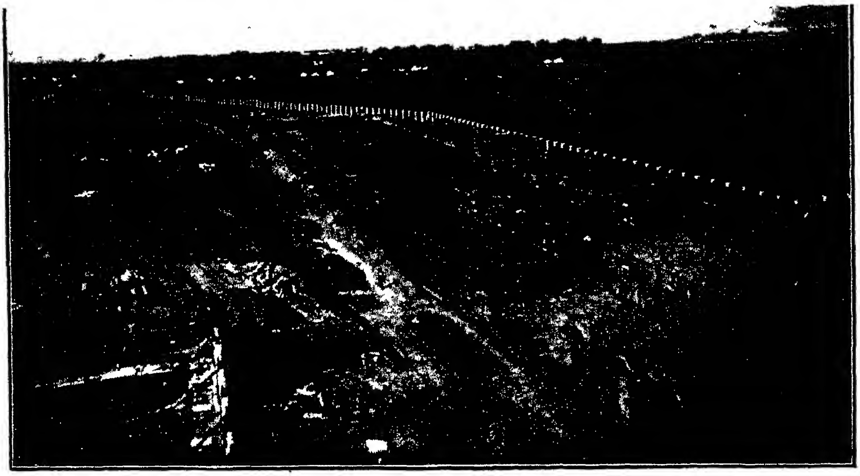

FIG. 1.—UNLOADING SUGAR BEETS FROM CARS INTO OPEN BINS. LOVELAND, COLO.

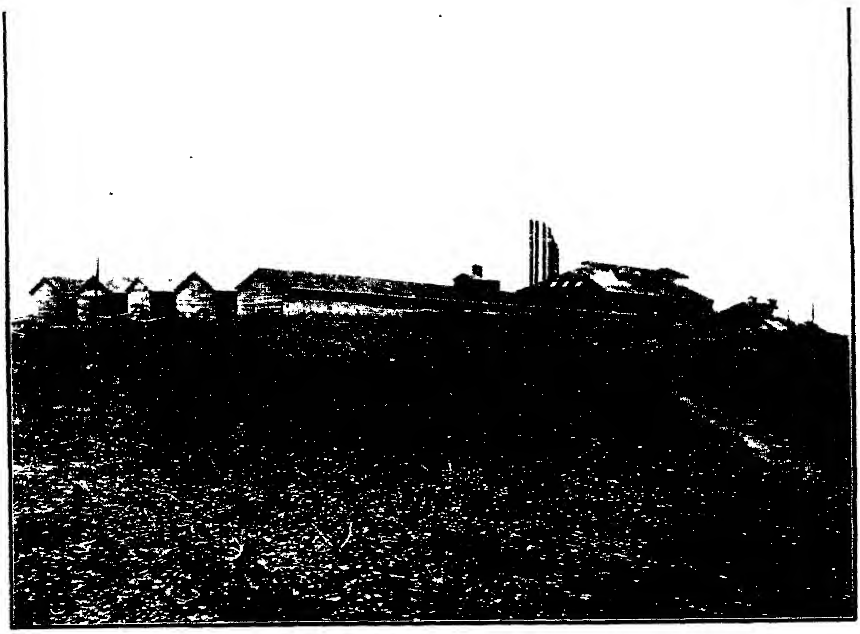

FIG. 2.—SUGAR-BEET SHED. OGDEN, UTAH.

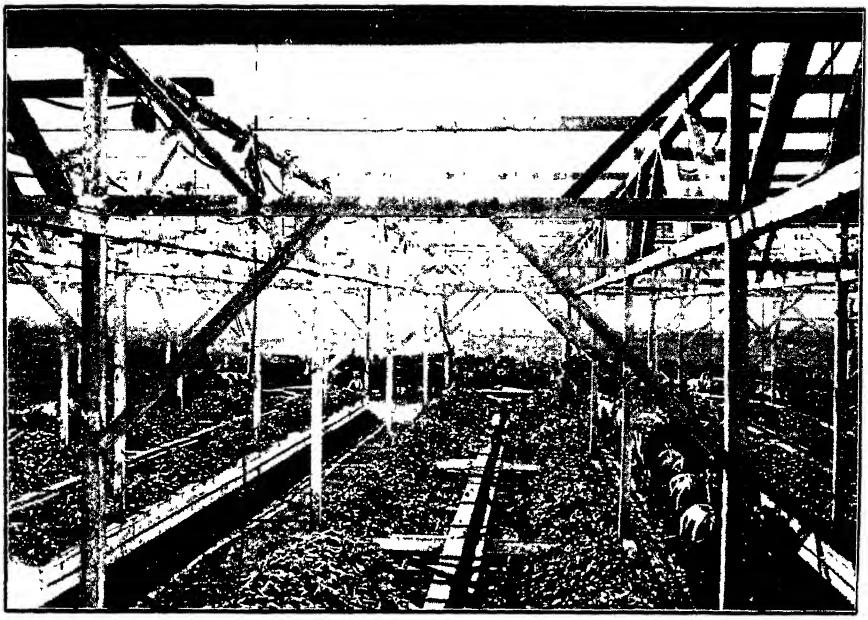

FIG. 1.—LOADED WAGONS ENTERING RECEIVING SHED AT BEET-SUGAR FACTORY. OXNARD, CAL.

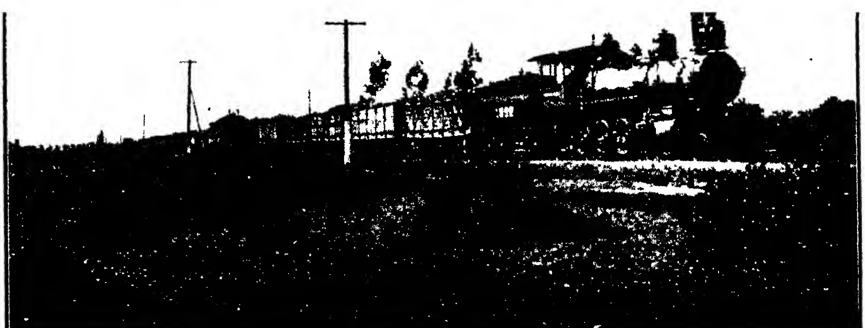

FIG. 2.—TRAIN LOAD OF SUGAR BEETS OXNARD, CAL.

Beet-sugar factories of the United States—Continued.

Name of company.	Location of factory.	Daily capacity in tons of beets.
OTHER STATES.		
Minnesota Sugar Co	St. Louis Park, Minn	350
Illinois Sugar Refining Co	Pekin, Ill	700
Continental Sugar Co	Fremont, Ohio	350
Wisconsin Sugar Co	Menomonee Falls, Wis	500
Pecos Valley Beet Sugar Co	Carlsbad, N. Mex	200
Washington State Sugar Co	Waverly	350
Oregon Sugar Co	Lagrande	350

The following statistics, taken from Census Bulletin No. 59, will no doubt be interesting as bearing on the growth and progress of the beet-sugar industry in this country:

Number and normal daily capacity of establishments in 1900, 1899, and 1898.

States and Territories.	1900.		1899.		1898.	
	Number of establishments.	Nominal daily capacity in tons of beets.	Number of establishments.	Nominal daily capacity in tons of beets.	Number of establishments.	Nominal daily capacity in tons of beets.
California	8	9,900	[a]8	9,900	5	4,400
Colorado	3	1,850	1	350	....	....
Illinois	1	700	1	700	....	....
Michigan	10	4,450	9	4,100	1	400
Minnesota	1	400	1	400	1	400
Nebraska	3	1,260	3	1,260	2	660
New Mexico	1	200	1	200	1	200
New York	3	1,000	2	400	2	400
Ohio	1	400	....	....	....	....
Oregon	1	350	1	350	1	350
Utah	4	[b]1,450	3	[c]1,100	2	750
Washington	1	350	1	350	....	....
Total	[d]37	22,310	[a]31	19,110	15	7,560

[a] Includes one idle establishment.
[b] Includes two auxiliary factories.
[c] Includes one auxiliary factory at which no sugar is manufactured, but juice is extracted from the beets and pumped to a central factory for treatment.
[d] Includes two idle establishments.

Statistics of beet-sugar factories in 1879, by States, Census of 1880.[a]

States.	Number of establishments.	Capital invested.	Average number of wage earners.[b]	Wages paid.	Cost of materials used.	Value of products.
California	2	$215,000	150	$39,131	$104,724	$162,988
Delaware	1	100,000	50	3,140	6,404	8,584
Maine	1	50,000	150	20,000	75,000	111,000
Total	4	365,000	350	62,271	186,128	282,572

[a] Data from Tenth Census, Manufactures, pp. 94, 101, and 127.
[b] Men, 16 years and over.

METHODS OF GROWING SUGAR BEETS.

It would be quite difficult to give general directions and rules for growing sugar beets applicable to all localities and conditions. Often expert sugar-beet growers, at public meetings and in the agricultural press, give minute directions covering all the details of this intricate process. Others, each well versed in the process of growing sugar beets, get into arguments and disputes as to the right method. In such cases each may be correct in a measure. The occasion for such disagreements lies in the fact that each person has in mind the right method for a particular locality or set of conditions. A careful study of the different sections of the United States where sugar beets are grown will lead to the conclusion that there is no single road to success in growing sugar beets. Every locality has settled conditions which will materially modify any set of methods that might apply to some other one. There are some settled rules, of course, but it is an actual fact that the various agricultural districts of this country will have to work out each for itself the right method. The person who argues that the ground must be plowed in the fall in order to receive the benefit of winter frosts is not offering any argument to the Pacific coast, for instance, where many beets are grown, and he who insists that the ground should be rolled in all instances after planting will hazard the crop if his directions are followed in many parts of Nebraska and other sections where the soil is sandy and there are strong winds. In such cases a smooth surface offers an excellent opportunity for the wind to carry along the sharp grains of sand, cutting off the plants and destroying the crop.

There can be no general fixed rules applying to the kinds and application of fertilizers. General principles are all right when accompanied with the underlying reasons, but must always be modified to meet local conditions.

With the development of the industry in all the sections which have the necessary conditions, and the acquirement of ample experience both by the farmers in the production of beets and by manufacturers in the making of sugar, there will come many improvements, and eventually a cheapening of production, a result of great importance to all concerned in the success of the industry, because eventually the beet-sugar industry of the United States will have to meet a sharper competition with foreign sugar producers.

There are some things settled, however, about growing sugar beets. It will generally be conceded that the ground should be plowed deep, and in most instances subsoiled. Before the seed is planted the ground must be thoroughly pulverized by harrowing and by rolling, even if the surface has to be afterwards roughened. Advantage must be taken of the general and prevalent rain conditions. The ground must be moist

FIG. 1.—PREPARING THE LAND FOR BEETS. SAN RAMON VALLEY, CALIFORNIA.

FIG. 2.—HARVESTING SUGAR BEETS. SAN RAMON VALLEY, CALIFORNIA.

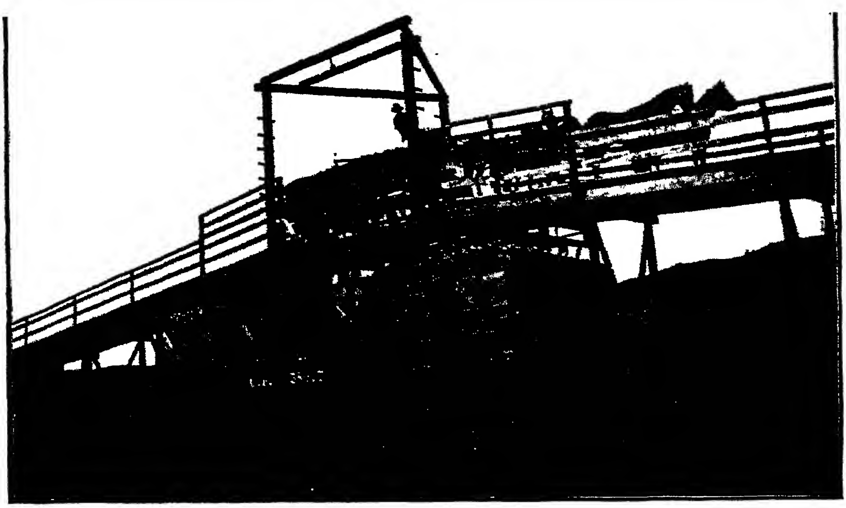

FIG. 3.—SUGAR-BEET DUMP. DANVILLE, CAL.

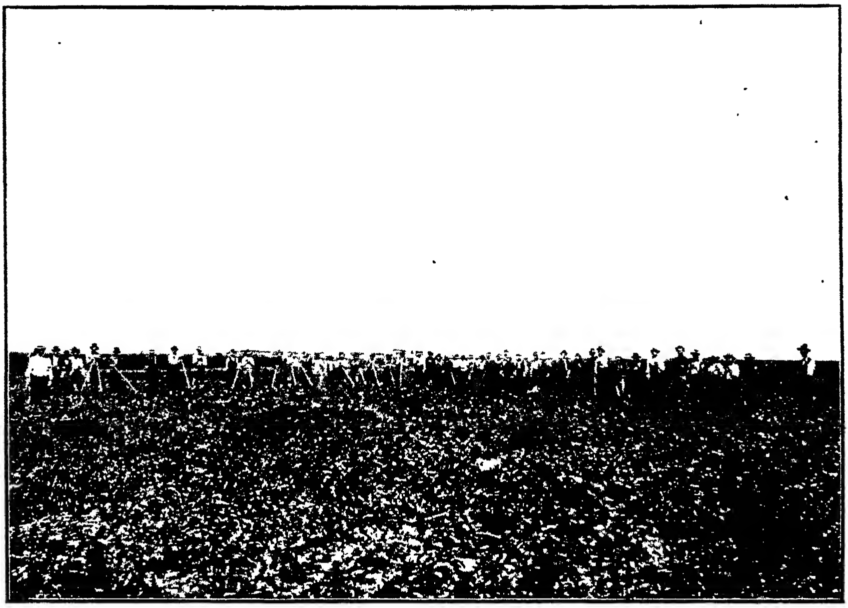

FIG. 1.—GROUP USING HOES IN SUGAR-BEET FIELDS. LEAVITT, NEBR.

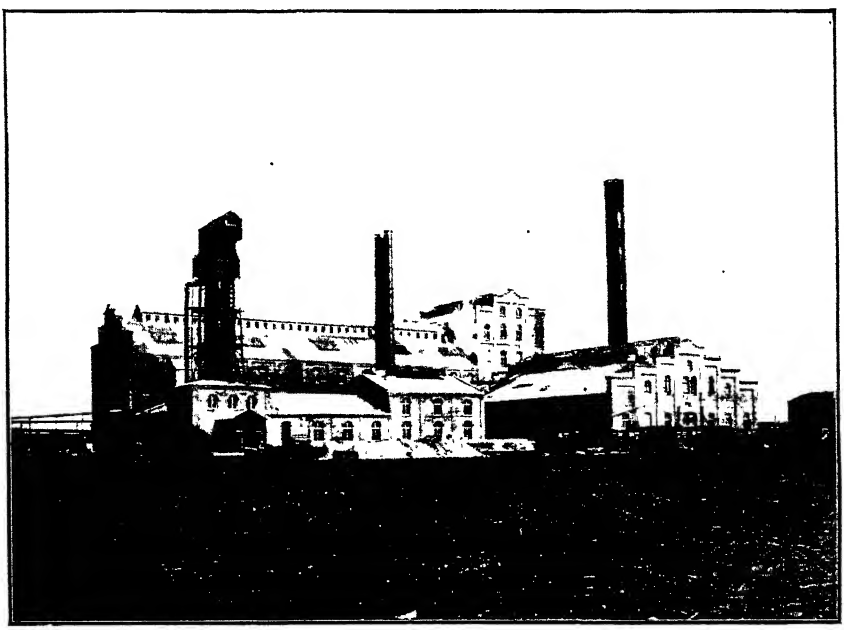

FIG. 2.—A BEET-SUGAR FACTORY. LEAVITT, NEBR.

enough to germinate the seed, either by rainfall or irrigation. Rainfall is best when it can be obtained. In some localities either is used, according to circumstances. Seeds are planted at depths of from one-half inch to 2 inches, according to the prevailing conditions in the particular locality. The beets must be planted near enough together to produce a beet of a certain size. This spacing depends, again, upon the locality and the nature and fertility of the soil. The size and quality of the beet depends materially on the right kind of spacing. The beets must be thoroughly cultivated, hoed, and hand weeded, because cultivation tends to conserve the moisture of the soil and clean fields permit favorable action of sun and air. This close cultivation should be kept up until the beet tops thoroughly shade the ground and reach a size when it would be injurious to operate among them further with a plow and hoe. The beets should be harvested as soon as possible after they are ripe, because then they contain the most sugar and the highest purity. It is evident that the entire crop of beets in the neighborhood of a factory can not be harvested at once. In many localities some will have to be siloed. Harvesting time will depend a great deal upon circumstances connected with the operation of the factory. The sooner the beet is harvested after it is ripe the better, because further rainfall may start a new growth, producing new lateral roots and new leaves, thus greatly reducing the sugar content and purity of the beets. (Pls. LXX and LXXI.)

BENEFITS TO THE FARMER GROWING SUGAR BEETS.

No statement of facts with reference to any new crop would be complete or would indicate the advisability of its introduction unless it showed the benefits to be derived. Of course, profit and loss in any enterprise is the first consideration.

PROFITS OF PRODUCTION OF SUGAR BEETS FOR FACTORY USE.

It has already been stated that it costs about $30 per acre to produce sugar beets and to market the crop where rain conditions prevail. This is without taking into consideration the rent of the land, but it includes the farmer's time and everything else that enters into the cost of production. The average yield is about 12 tons per acre. Probably this cost of production will be gradually reduced because of improvements in implements and methods. The beets grown have a gross value at the factories of $4 to $4.50 per ton (in States paying no bounty). This gives a gross return per acre of $48 to $54, and a net profit of $18 to $24. It must be kept in mind that these are averages of gross and net proceeds. It is never very encouraging to consult the average of agricultural crop statistics; indeed, it is often said that "the average crop does not pay." If one should take the figures of the average crop of corn in Iowa, for instance, or the average crop of

wheat in Minnesota or Kansas, and compute the proceeds at the average market price, and deduct therefrom the cost of production, the results would show a very small remuneration or an actual loss, quite discouraging to one who has not investigated this subject.

Taking what seems to be the most authentic figures, the cost of producing sugar beets in sections where they are grown by irrigation is about $40 per acre. An average of 13 tons per acre can be produced, having a higher sugar content, and worth $4.50 to $5 per ton, making the gross proceeds $58.50 to $65, and the net profit $18.50 to $25 per acre. These figures give to the farmer in each case a profit greatly more satisfactory than in the case of other crops. But the successful farmer will never be satisfied with the average proceeds of any crop, and it is to him we must look for the results that give the more encouraging inducements to beet culture. Many growers receive as high as $75 and some as high as $100 per acre for their beets, these high results depending upon the superior quality of the land and the superior skill of the one producing the beets. If a farmer has poor land, or is a poor farmer, he is not in position to expect much in planting any kind of crop. These statements are sufficient to give a farmer who is experienced in all other kinds of crops a fair insight into the situation.

BEETS AS A STOCK FOOD.

There are indirect benefits in sugar-beet growing that the farmer must take into consideration, along with the direct, as follows: He learns that sugar beets are a very valuable crop to grow for his stock. It is estimated that they are worth two-thirds as much for feeding as for the production of sugar. They may enter into a food ration for any kind of stock. The farmer growing beets for a sugar factory retains for feeding the beets that have been "docked," or that are liable to be. He constructs root cellars and stores them away, and they enter largely into all animal food rations for winter feeding. For stock feeding, sugar beets have both a nutritive and a sanitary value.

IMPROVEMENT OF LAND AND METHODS OF FARMING.

The high cultivation that must be given the land through deep plowing, thorough harrowing, and constant weeding and cultivating finally makes the land of superior quality for any purpose. It will grow better corn or wheat, and at a less expense, on account of the absence of weeds and grass. Finally, through rotation, other fields are brought under this high state of cultivation, until the whole farm is at its best condition of soil fertility and productiveness.

The method that has brought this about serves as an object lesson to the farmer and the farming neighborhood. A better cultivation will prevail, and the science of farming will become several degrees higher on account of experience in sugar-beet cultivation.

FEEDING PULP.

After the beets are delivered to the factory and the sugar has been extracted, it is found that the pulp (which will amount to 50 per cent in weight of the beets worked) is almost as valuable for feeding purposes as the original beets themselves. It is a very cheap feed, and sells for 35 to 50 cents per ton. It enters naturally and profitably into the food rations of all kinds of stock. It is especially valuable for steers, lambs, brood mares, and brood sows, but reaches its highest use as animal food when fed to the dairy cow. The farmers in the neighborhood of a beet-sugar factory feed large quantities of it. They appreciate its nutritive and sanitary value. Pulp feeding gives an impetus to animal industry of all kinds. It offers a stimulus to the establishment of butter and cheese factories, to the erection of feeding pens, and to the whole stock-feeding industry. Its use is one of the strong reasons for establishing the industry.

The beet-sugar industry opens up at once a large demand for labor, not only in the factory itself but on the farm. It is one of the things in which the farmer can invest with the assurance that he has a sure market and a fixed price for his crop to begin with.

BENEFITS OF BEET-SUGAR INDUSTRY TO OTHER INDUSTRIES.

The establishment of a beet-sugar factory opens up not only a large field for the employment of labor, but also a field for the employment of capital. It becomes at once a market for considerable crude material to be used in conducting the business. First and most important, it furnishes a market for the beets. Then the factory is a large consumer of coal, and as the factories are often established in communities having local coal fields, they become at once local markets for a local product. The amount of coal necessary to work up a certain amount of beets is generally computed at about 17 per cent by weight, or in case of an ordinary factory of 350 tons capacity about 60 tons of coal per day, or 6,000 tons for a full campaign of one hundred days. A factory also consumes a large amount of lime rock, which of necessity must also be a local product. It usually consumes lime rock to the extent of about 10 per cent of the crude weight of beets worked, which in the case of a 350-ton factory would be 35 tons of lime rock per day, or 3,500 tons for the campaign. It consumes about one-fifth as much coke as lime, or a little less than 700 tons during a campaign.

The establishment of a factory in a community necessitates considerable transportation of crude products—beets, coal, and lime rock—to the factory, and in carrying the finished product to the market. It stimulates banking and almost all kinds of mercantile business throughout the community.

THE FUTURE OF THE BEET-SUGAR INDUSTRY.

The following figures will give an idea of the possibilities for the expansion of the beet-sugar industry in the United States.

Consumption, production, and importation of sugar.

		Tons.
For 1901 the total consumption of sugar in the United States was		2,372,000
Adding to this the average yearly increase, based on an estimate for twenty years, the consumption of sugar for 1902 will be		2,478,000
To meet annual requirement there must be imported into the United States proper this 2,478,000 tons, less what this country manufactures. The home production for 1902 should be about as follows:		
Cane sugar of the South	300,000	
Beet sugar of the North and West	185,000	
		485,000
Balance imported		1,993,000
Requirements from outside for 1902 will be in round numbers		2,000,000
Of this amount from insular possessions, free of duty, there will be received—		
From Porto Rico about	100,000	
From Hawaii about	300,000	
		400,000
There must be secured from strictly foreign sources, duty paid		1,600,000

It is the ambition of those encouraging the beet-sugar industry to establish factories enough at least to furnish this foreign importation. Making due allowance for failure of factories to reach in actual production their full capacity under ideal conditions, it would require 500 factories having a daily capacity of 500 tons of beets to produce the sugar imported, or a sufficient number of cane-sugar factories to produce an equal amount of sugar. As a matter of fact, there is likely to be a rapid increase in both beet-sugar and cane-sugar factories. But for convenience, the calculations here made are based on the supposition that the increase will be in beet-sugar factories only. In order to equip and build these factories it will require an investment of capital of $250,000,000. This vast sum of money must be expended in this country for building materials and machinery and in the employment of the labor necessary to construct and equip the factories. The annual requirements of these factories will be as follows:

Annual requirements of 500 beet-sugar factories.

They will require of beets ....tons..	18,750,000
pay farmers for the beets	$84,375,000
require of coal ....tons..	3,187,500
pay the coal dealers	$9,562,500
require of lime rock ....tons..	1,875,000
pay to the quarries for lime rock	$3,750,000
require of coke ....tons..	375,000
pay to the coke dealers for coke	$3,000,000
for labor in the factories	$19,000,000

In addition to the above list, large amounts of money will be paid for mill supplies, transportation, etc. As working capital to operate these factories $135,000,000 will be required. This sum being in use, however, for about four months in the year, the interest charge thereon is equal to an interest charge on $45,000,000 for one year. It should be remembered that the above estimates do not include the capital already invested in the business and the operations of the factories already built, the statement of which is as follows:

Present development of the beet-sugar industry.

Capital invested in factories, equipment, and grounds	$30,000,000
Beets purchased annually ....tons..	1,875,000
Cash paid for beets purchased annually	$8,437,500
Coal consumed annually ....tons..	318,750
Cash paid for coal annually	$956,250
Lime rock purchased annually ....tons..	187,500
Cash paid for lime rock annually	$375,000
Coke purchased annually ....tons..	37,500
Cash paid for coke annually	$300,000
Cash paid for labor annually	$1,900,000
Operating capital annually employed	$5,000,000

Also, there is a considerable amount annually expended for crude material and various other things. It hardly seems possible that an industry which affects so many people over such a wide scope of country can fail to receive anything but the most friendly, careful, and fostering consideration on the part of those who shape industrial affairs.

The immensity of future demands, it seems, answers effectually those who feel that the industry might be overdone. Attention should be called to the fact that not only are present demands great, but that the rate of increase of consumption is considerable. According to careful statistics for the last nineteen years, consumption of sugar in this country has been increasing at the average rate of about 6½ per cent annually.

The table on the next page shows the consumption of sugar in this country from 1881 to 1901, the percentage of increase, and the consumption per capita.

Consumption of sugar in the United States, 1881–1901.

[Willett & Gray.]

Year.	Total amount of sugar consumed.	Increase (+) or decrease (−) as compared with previous year.	Consumption per capita.	Year.	Total amount of sugar consumed.	Increase (+) or decrease (−) as compared with previous year.	Consumption per capita.
	Tons (2,240 pounds).	*Per cent.*	*Pounds.*		*Tons (2,240 pounds).*	*Per cent.*	*Pounds.*
1881	903,532	....	....	1892	1,853,370	−1.10	63.76
1882	1,061,220	+ 6.80	....	1893	1,905,862	+2.83	63.83
1883	1,170,375	+10.30	....	1894	2,012,714	+5.08	66.64
1884	1,252,366	+ 7.00	51.00	1895	1,949,744	−3.27	64.23
1885	1,254,116	+ 0.14	40.95	1896	1,940,086	−0.53	60.09
1886	1,355,809	+ 8.11	52.55	1897	2,070,978	+6.79	63.50
1887	1,392,909	+ 2.73	53.11	1898	2,002,902	−3.29	60.30
1888	1,457,264	+ 4.62	54.23	1899	2,078,068	+3.75	61.00
1889	1,439,701	− 1.21	52.64	1900	2,219,847	+6.82	66.60
1890	1,522,731	+ 5.80	54.56	1901[a]	2,372,000	+6.85	70.00
1891	1,872,400	+22.96	67.46				

[a] Added by the writer of this paper.

The rapid growth in consumption of sugar may strike one at first as hard to understand, but a closer investigation reveals that it is one of the natural results of the rapid development that characterizes all the industries of this country. Not only is sugar used as an article of diet, but it is required in large quantities in the manufactures, arts, and sciences, this being the principal cause of the increased consumption. While it is a fact that the daily table use of this article grows as wealth accumulates, this would not by any means account for the large increase in consumption. Throughout the whole country, especially in the mountain and Western States, there has been rapid development of very productive fruit districts. Irrigation has played an important part in extending the fruit industry. These orchards and patches of small fruits have been coming gradually into production. Many of them are distant from the markets. These products are of a perishable nature, and can not be distributed to consumers in a fresh state. Canning industries and preserving industries of all kinds have been installed to work up these products. Sugar is required in large quantities in preserving and canning fruits. Like other industries, the prepared-fruit industry has to find a market. It has accomplished this not only at home, but to some extent in foreign countries. Each year sees a large increase in the supply of fruit that must be treated in this way, and each year has seen a consequently large growth in home and foreign trade in these products. It can be seen naturally that the increase in the demand for sugar in this direction has been enormous; yet the fruit industry is only in its infancy.

THE SUGAR-BEET BELT.

Experience throughout the United States has demonstrated that sugar beets do best in localities having certain climatic conditions. Up to date a large strip of land reaching across the northern portion of the country has given the most satisfactory results in growing sugar beets. It starts at the Hudson, takes in the southern half of New York, the northern portions of Pennsylvania, Ohio, Indiana, Illinois, Iowa, and Nebraska, the southern half of Michigan, Wisconsin, and Minnesota, all of South Dakota, large sections of Colorado, Utah, Wyoming, Montana, Idaho, Washington, and Oregon, and the coast side of California.

The mapping out of this belt is based on temperature conditions only. Throughout large areas included in the belt other conditions make the growing of sugar beets either impossible or unprofitable. But there are many districts where this industry succeeds. The actual location of such can only be determined by experiment. It would be impossible to locate them on a map at present, as many of them are as yet undetermined. By consulting the published experimental results in bulletins of the State experiment stations and the reports that have been isued by the Department of Agriculture much accurate information can be obtained with reference to many of these lands. There are valleys in the arid regions of the Rocky Mountains having the right conditions, with sufficient water supply for irrigation, that have reached results never before equaled with sugar beets even in countries that have been working with the industry for a half century.

The State agricultural experiment stations have done much pioneer work in determining whether the prevalent conditions in their respective States are favorable or unfavorable to the beet-sugar industry. The Department of Agriculture has given considerable attention to this problem. It has cooperated with the State experiment stations so far as feasible, has pursued independent investigations wherever practicable, and has published the results in reports and bulletins. These results are given by counties and States, and show averages of quality and purity of sugar beets grown; they have also been placed in comparison with the results arrived at by the experiment stations. This work has been repeated year after year, so that the public might discern the extreme either of favorable or unfavorable years and estimate the effects of normal conditions in normal years.

RESULTS IN 1901.

The point of development reached by the beet-sugar industry can be shown in no better way than by citing statistics of the results accomplished the past year. There were 36 factories in operation, besides 3 slicing stations. During the "campaign" of 1901 these factories worked up 1,685,688 tons of beets grown on 175,083 acres of

land. The average yield per acre of beets was 9.6 tons, and of sugar 2,109 pounds. The total product of all the factories was 369,211,733 pounds of sugar. In making this sugar, the factories used 163,322 tons of limestone, 210,229 tons of coal, 669,509 barrels of fuel oil, and 4,000 cords of wood. The factories gave employment to 8,762 hands, at an average daily wage of $2.16. The beets worked averaged in sugar content 14.8 per cent, and in coefficient of purity 82.2. The average length of campaign of the 36 factories was eighty-eight days.

Three States (California, Utah, and Colorado) produced more sugar than the amount consumed by their respective populations, and Michigan did not fall very far short of the same result. The combined beet-sugar product and cane-sugar product of the United States for 1901 was equal to the estimated consumption of sugar in the entire territory lying west of the Mississippi River, exclusive of Missouri, Iowa, and Minnesota.

The total beet-sugar product of the United States for 1901 was more than double the product of any previous year, and for both beet growers and sugar manufacturers the year was the most prosperous in the history of the industry.

AGRICULTURAL INVESTIGATIONS IN THE ISLAND POSSESSIONS OF THE UNITED STATES.

By Walter H. Evans, Ph. D.,
Of the Office of Experiment Stations.

INTRODUCTION.

Since the extension of the sovereignty of the United States over Porto Rico, Hawaii, and the Philippines many inquiries have been made concerning the agricultural conditions and possibilities of these islands and what has been done to develop their resources. In preparing this paper official reports, books of travel, proceedings of societies, correspondence, and individual statements have been made use of to the fullest extent. An attempt has been made to show briefly the general condition of agriculture, the present status of the principal agricultural industries, and to trace the attempts that have been put forth to improve the agriculture of the islands. For the first time strictly tropical conditions as factors in agricultural development have to be dealt with by us. During the year ending June 30, 1900, the United States expended more than $300,000,000 for tropical agricultural products. Of this large sum, with the exception of sugar, only a comparatively small portion came from the newly acquired possessions. That these islands are capable of increasing the total of their products can not be doubted, and the efforts of the Department of Agriculture are directed to this end. To aid in this work, agricultural experiment stations have been organized by the Secretary of Agriculture, under the immediate control of the Office of Experiment Stations, in Porto Rico and Hawaii; and Congress has been asked for a similar station in the Philippines. The agriculture of these islands is as old or older than that of this country. At some time the cultivation of nearly every crop of tropical or temperate regions has been introduced and has flourished for a while, after which the industry, with rarely an exception, has been abandoned or allowed to become of small importance. New industries are not of immediate necessity, but old ones should be revived and developed under more enlightened management. The introduction of new and improved varieties, scientific methods of cultivation, modern machinery, proper methods of handling products, discovery of means for combating insect and fungous diseases—all of these will aid in reestablishing and developing decadent industries. The questions of labor, markets, and transportation are

of great importance, but they are economic rather than agricultural, and therefore beyond the scope of the present paper.

INVESTIGATIONS IN PORTO RICO.

HISTORICAL.

Porto Rico, with an area of about 3,668 square miles, has a population of nearly 1,000,000, which is more than 260 inhabitants per square mile, and the greater number of its people are directly engaged in agricultural pursuits.

The colonization of the island began in 1508, or about a century before the earliest English settlements in the United States. For a long time the colony, which followed a sort of patriarchal life, had but little growth, and commerce, so far as exports were concerned, was of small importance. The system of monopolies and special favors granted to individuals and localities in Spain was decidedly prejudicial to the industries of the island. Industries were often prohibited or so taxed for the benefit of the mother country that there was little development of the resources of the island. As an example, flouring mills were not allowed or were so taxed that flour, often ground from American wheat, was brought from Spain cheaper than it could be produced in the island. The growing of grapes was restricted in order to furnish markets for Spanish wines, although there are areas of considerable extent in the island where grape growing may be followed with success. In 1815 foreigners other than Spaniards were allowed to acquire lands in Porto Rico, and many settlers came from the English and French West Indies. In 1816 the severe restrictions were further modified, and what has been denominated as the golden age of Porto Rico began. From that time the population rapidly increased and agriculture and commerce were greatly developed.

THE MAIN INDUSTRIES OF PORTO RICO.

The main industries of the island are the growing of coffee, sugar cane, and tobacco, and stock raising. These industries have shown great fluctuation from time to time, dependent upon a number of factors. Carelessness and ignorance of methods, use of antiquated implements, and lack of transportation have all served to retard the fullest measure of success. While the majority of the people of the island are immediately dependent upon agriculture, yet there are not sufficient breadstuffs grown to supply the demand, and fully half the imports are of agricultural products. Most of the lands of the island are susceptible of cultivation, even well up the mountain sides. The climate is tropical, and except upon the southern side of the island the rainfall is adequate for crop production. Along the coast are stretches of sand adapted to cocoa palms, and other tracts, which, if

diked and drained, would be splendidly adapted to rice and cane. The valleys are of great fertility, some of them having been cropped for generations without rotation or application of fertilizers. At the higher elevations the necessity of fertilizers is beginning to be seen, but little is known of their proper use. The latest available statistics show the following areas planted to crops: Coffee, 121,176 acres; cane, 60,884 acres; tobacco, 4,222 acres; and minor crops, including vegetables, fruits, etc., 118,682 acres—a total of 304,964 acres. In other words, less than one-eighth of the land of the island is under cultivation.

COFFEE.—Coffee, which is the principal export crop, is produced to some extent in nearly every district of the island. The maximum production was reached in 1896, when 58,780,000 pounds, valued at 23 cents per pound, or a total of $13,519,400, were exported. Most of this was sent to Europe, Spain alone taking 16,405,000 pounds, while the United States received less than 1 per cent of the exports. With the changed political relations of the island and the general lowering of the price of coffee in the world's markets, the condition of the planters had become anything but prosperous when the hurricane of August, 1899, completely destroyed many plantations, and little if any effort has been put forth to restore many of them. The methods of planting are haphazard, and the question of shading is not thoroughly understood. Little attention has been given to selection for quality or yield. The production varies from 100 to 400 pounds per acre, but this could readily be increased to 1,000 pounds with better methods. The quality of the better grades excels that of much of the coffee found in the markets of the United States, only the lower grades competing with the products of Brazil. Porto Rico coffee does not seem to have taken well in the markets of this country, owing, doubtless, to ignorance of the quality on the one hand and to the method of preparation on the other. For the markets of Europe a polished grain, colored with indigo, is demanded, while in the United States an uncolored grain is preferred. With improved methods of handling, greater productiveness, and perhaps larger consumption in the United States, the coffee industry of the island should be restored to a flourishing state.

SUGAR.—The sugar industry has had a fate somewhat similar to that of coffee, although at present it is in a flourishing condition, and considerable capital is being invested in sugar plantations and mills. In 1899 there were but two modern sugar mills on the island. The sugar estates ranged from a few acres to 1,000 acres in extent. The methods of planting, cultivation, and manufacture were antiquated, and the average production was but 1,400 to 1,800 pounds of sugar per acre. By adopting modern methods of cultivation the yield could doubtless be increased to three or four times that now secured. Crop rotation, use of fertilizers, improvement in variety of cane, and establishment of

central mills would all tend to increase the production and lessen the cost. In the hurricane of 1899 the sugar plantations did not suffer as severely as the coffee groves. While considerable injury was done, much of the soil washed from the hills was deposited upon cane lands, to their great benefit. Lack of means of transportation has seriously retarded the development of this, as other industries.

TOBACCO.—The agricultural industry of third importance is tobacco growing. This industry reached its maximum production in 1889, when exports valued at $1,104,000 are reported. From that date there seems to have been a general decline in production, and in 1896 tobacco to the value of only $402,000 was exported. Since 1898 a considerable trade has been developed between Porto Rico and the United States, and the tobacco industry is beginning to flourish once more. The area devoted to this crop can be considerably extended, but better methods of cultivation, and, above all, of curing and fermenting the crop, must be introduced. In the past much of the Porto Rico crop was sent to Cuba, whence it found its way to other countries as Cuban tobacco, but with better curing, fermentation, and sorting it will be able to stand on its own merits.

STOCK RAISING.—Stock raising has long been a profitable industry. Cattle flourish and fatten upon the luxuriant grasses, and have little to contend against in the way of annoying insects. The consumption and exportation of cattle are estimated at 50,000 head annually. Pork to the value of more than $1,000,000 is imported, much of which could and should be produced in the island. There are considerable possibilities in dairying. The cattle now in Porto Rico are well adapted for beef and work oxen, but are very poor as dairy animals, their milk being small in quantity and inferior in quality. Butter sells at from 60 cents to $1 per pound and milk at 8 to 12 cents per quart. Cream is almost unknown, as also is cheese of local production. Of the latter, more than 1,500,000 pounds are annually imported. With more knowledge of how to handle dairy products, and by the importation of breeds of cattle of recognized dairy strains, especially if artificial cooling plants should be secured, the production of butter and cheese would be feasible, and fresh milk and cream of qualities now unknown would be obtainable.

POSSIBILITIES OF FRUITS, VEGETABLES, AND RICE IN PORTO RICO.

Fruit and vegetable growing as industries are practically unknown. Every laborer has a small garden in which a few yams and bananas are produced, and oranges, guavas, and many other tropical fruits grow almost everywhere. While fruits are of common occurrence, there appears to have been little done to improve the quality. The oranges are full of seeds, contain a great amount of rag in proportion to the edible part, and vary so greatly that anything like a constant quality

in any large quantity can not be secured. Most of the vegetables are poor in quality and seem to be degenerate representatives of old stock. With care in planting, selection of improved varieties, and attention to the market requirements, Porto Rico could readily supply our markets with many of its fruits, to the very great benefit of the grower and gratification of the consumer. In addition to the well-known fruits and vegetables, it could furnish the United States with many tropical fruits now almost unknown in our markets; but to do this would require rapid and regular transportation, which will no doubt be forthcoming when the demand is sufficient to justify the use of additional vessels.

The growing of rice should be more generally pursued than is now the case. In 1895 nearly 75,000,000 pounds of rice were imported, most of which came from Spanish, German, and English ports. If drained and protected by dikes, there are considerable low areas adapted to rice growing, and there are numerous varieties of upland rice that could be introduced with advantage.

EFFORTS OF THE INSULAR GOVERNMENT TO IMPROVE CONDITIONS IN PORTO RICO.

After the great hurricane of 1899, and to the beginning of 1900, conditions on the island were anything but favorable for the development of any industry, but by wise and conservative action on the part of the authorities the political condition in the island has improved and the economic status is improving. To assist in the development of the agricultural industries a number of measures have been begun. Large sums have been expended by the insular government in road making, first as relief work, and later as a necessary preliminary to agricultural development. Crops can not be marketed without roads, and these are being provided as rapidly as the resources of the island will permit. A road of the first class has been built from Ponce to Arecibo, which is west of the center of the island, and the construction of others is in progress. Aside from the military road from San Juan to Ponce, the Ponce-Arecibo is the greatest road-making enterprise ever undertaken on the island, and it opens up a region of great fertility and resource. The budget for the current year carries for road making $700,000, or almost one-third of the total revenue of the island. The system of roads now planned and constructed embraces nearly 900 miles, so that when complete the island will not lack for means of transportation.

A second need, and what is considered by some who testified before Commissioner Carroll as of immediate importance, is scientific instruction in agriculture. There appears to have been but little done in the way of agricultural investigation during the old régime. A mutual society for the promotion of agriculture was formed and continued for a number of years. Its headquarters were in San Juan, and branches

were established in every town of importance, but there were no permanent results from this enterprise. In 1864 an exposition of the products of the island was held at San Juan, and a like affair was held at Ponce in 1882. These were similar to the State or county fairs of this country, and were for the years named only.

In 1889 the Spanish Government established two experiment stations in the island—one at Rio Piedras, near San Juan, and the other at Mayaguez, but both, after costing the province considerable sums of money, were discontinued in 1897 without having seemingly accomplished much of value. The station at Rio Piedras consisted of 1 acre of ground, on which was erected a small frame building. The land was donated for experimental purposes, and reverted to the owner upon its abandonment. No records of experiments or equipments appear to have been kept, and nothing seems to have been accomplished. The director of the station published a treatise entitled "La Reforma Agricola," which was a theoretical discussion of the agricultural organization which he thought should exist on the island, including banks, insurance, taxes, fairs, agricultural schools, etc. He also published two compilations relative to the cultivation of tropical crops. The station at Mayaguez consisted of 7 acres of land, a small residence and office building, and servants' quarters. No other improvements appear to have been attempted, and no field experiments are reported to have been inaugurated. A small lot of chemical apparatus and a library of 40 or 50 volumes seems to have been the equipment of the station. No records are available and no publications can be traced to the station. It is reported that the director started the manufacture of fertilizers, but the process proved too expensive and was abandoned. The equipment of this station is now in possession of the insular government, and the Rio Piedras station is used as a laboratory for the manufacture of vaccine virus.

ESTABLISHMENT OF A FEDERAL EXPERIMENT STATION IN PORTO RICO, AND ITS WORK.

In response to urgent requests, Congress, in the appropriation bill for the Department of Agriculture for the year ended June 30, 1901, made an appropriation of $5,000 for a preliminary survey of the agricultural conditions of Porto Rico, with special reference to the establishment of an experiment station. Acting upon the authority given him, the Secretary of Agriculture sent Prof. S. A. Knapp, formerly of the Iowa experiment station, and more recently engaged in agricultural pursuits in Louisiana, to Porto Rico to make the investigation. Professor Knapp visited the island during the summer of 1900, and later in the season made his report, which was transmitted to Congress and published as House Doc. No. 171 (Fifty-sixth Congress, second session). This report contains a summarized statement regarding the climate, soils, and condition of agriculture of the island, and shows in

what way agriculture might be aided by an experiment station, which was recommended to be established as soon as practicable. It was recognized that a station could not be maintained as a strictly scientific institution at once, but that the investigations should be supplemented by object lessons in improved farming and by the dissemination of information in every way possible. With a population of which more than three-fourths is illiterate, it would be impossible to conduct a station upon the lines that would be laid down for one in a more educated community; object lessons and primary teaching would of necessity be of first importance, scientific investigations being subordinate. On the basis of Professor Knapp's report, Congress made a second appropriation ($12,000) and authorized the Secretary of Agriculture to establish and maintain an experiment station in Porto Rico. Mr. Frank D. Gardner, then an assistant in the Division of Soils, was transferred to the Office of Experiment Stations and placed in charge of the agricultural investigations in Porto Rico. Mr. Gardner proceeded to Porto Rico early in May, 1901, and spent some time in familiarizing himself with the people and the condition and needs of agriculture.

In the location of the station more difficulty was experienced than was anticipated. A circular letter was sent to the different municipalities calling attention to the advantages of an agricultural experiment station, and asking what lands could be donated in their vicinity. The replies, as a rule, showed that the municipalities possessed no lands suitable for the purpose, and their straitened financial circumstances would not allow them to make desirable purchases. The appropriation of Congress was insufficient to allow of the purchase of land, so arrangements were made for a temporary location of the experiment station at Rio Piedras, near the site of the former agronomic station. Thirty acres of land adjoining the village, and about 7 miles from San Juan, have been leased, together with a large frame house, which will temporarily serve as residence, office, and laboratory. In addition to this tract, the normal school, located near by, has granted the temporary use of 40 acres of land for experimental purposes. The necessary animals and implements have been secured and preparations are under way for clearing and planting part of the land. The legislature of Porto Rico, now in session, appropriated $15,000 for the purchase of a suitable tract of land for the use of the station. As the money was made immediately available a permanent location will soon be acquired. The work already begun includes experiments with vegetables and other rapid-growing crops which do not occupy the land a long time. The time and method of planting, use of fertilizers, variety tests, etc., will be investigated. Cooperative investigations are planned, and one with coffee has already been begun. These experiments consist of attempts to improve the yield and quality of

coffee by selection, breeding, and propagating, and in restoring old groves by removing part of the shade, thinning, pruning, etc.

Investigations have also been begun to discover means for combating troublesome insects, especially the "changa" (*Gryllotalpa hexadactyla*), a kind of a mole cricket, which has become very troublesome. It is believed this insect was introduced from South America in guano. It is very destructive to a wide range of plants during the period of their early growth, being especially troublesome to vegetables on sandy soils; it is also destructive on the sugar and tobacco plantations, often necessitating numerous replantings. It works at night, burrowing under the ground and eating the young plants off at the crown. When its food becomes scarce it migrates at night to quite a distance. Its nocturnal habits, mode of flight, and manner of working beneath the surface make it a formidable pest to combat. Experiments with barriers, traps, fertilizers, etc., have been begun, but it is yet too early to predict results. Investigations will be undertaken in combating scale insects and fungous diseases which attack citrus fruits as soon as the time can be spared from other pressing duties. This subject is of immediate importance to orange planters.

It is the intention of the director of the station to take up the subjects of forage plants and dairying as soon as the resources of the station will permit. With the increase in the area of cultivated lands that seems inevitable, the pastures will be reduced, and when this time comes there will be an urgent demand for more and better forage crops. Experiments in swine and poultry breeding will be undertaken to show how the present supply may be improved and augmented. The soils are to be studied and mapped to show what areas are adapted to different crops, and this work has already been begun in cooperation with the Bureau of Soils of the Department of Agriculture. Studies in the curing, fermentation, and grading of tobacco are also needed to aid in improving the quality of this crop; but these, as well as many other investigations, such as in cane improvement, rice growing, irrigation, foresty, fruit growing and marketing, fiber plants, cacao, etc., can not be given the attention they deserve with the present limited resources at the disposal of the station.

The staff of the station as organized at present consists of a special agent in charge as director, entomologist and botanist, and farm foreman. With the station permanently established it will be possible to develop the work along the lines indicated, as well as be prepared for other duties that may arise.

INVESTIGATIONS IN HAWAII.

HISTORICAL.

Agriculture in Hawaii may be said to be a development of the nineteenth century. When Captain Cook made his first visit to the islands in 1778 he found taro, sweet potatoes, bananas, plantains, breadfruit, sugar cane, cocoanuts, ava roots, a large, sweet root (probably the root of the ti plant), gourds, fowls, swine, dogs, geese, and pigeons, which were doubtless brought by the natives when they made their exodus from the South Sea Islands. Captain Cook at this time left on one of the islands goats, swine of English breed, and seeds of watermelon, pumpkins, and onions. Upon his return, fourteen years later, these were all being rather extensively produced. In 1792 the islands were visited by other voyagers, and Captain Colnet left a ram and a ewe on Kauai, and Vancouver gave to the residents of Hawaii grapevines, orange trees, and garden seeds. In 1793 Vancouver again visited the islands and left a number of goats, sheep, and geese, and the first cattle, the latter being protected by royal decree for ten years against slaughter, except in the case of an excess of male animals. He is said to have introduced the first agricultural implements and domestic utensils at this time, which were to supplant the crude articles of native manufacture. To Don Francisco de Paulo Marin the islands are especially indebted for the introduction of many seeds, roots, and plants, and for the instruction he gave in their cultivation and utilization. He is supposed to have arrived in the islands about 1791, and served the King and his people in many capacities. He kept a diary of the events of his life, and although some of the earlier volumes are lost, the record from 1809 to 1820 is reasonably complete. He records the planting in 1813 of pineapples, oranges, beans, cabbages, potatoes, peaches, cherimoyas, horse-radish, melons, tobacco, carrots, asparagus, maize, figs, lemons, and lettuce; he also began the manufacture of oils, candles, and cigars, and made hay. Early in 1815 he was engaged in planting a vineyard for the King, and later he reports having made 38 gallons of wine, whether from his own plantings or from the vines left by Vancouver in 1792 is not stated; also, 5 flasks of brandy and a barrel of beer. In 1817 he says he planted cotton, coffee, cloves, tomatoes, turnips, peppers; sowed wheat and barley and burned lime; made pickles, soap, molasses, and sirup of lemon juice, etc. In 1819 he reports having made sugar, and sold a lot of vegetables to the French war sloop *Descubierta*. On September 22, 1819, he reports having gathered the first ripe orange from trees planted as seeds eight years before. Marin died in October, 1837, having devoted much of his time to his experimental garden and to the development of many industries which he sought to introduce among the natives. To him can doubtless

be given the credit of having been the first agricultural investigator of the islands.

Horses were first introduced in 1823, and between 1824 and 1838 many cargoes were landed from California. Little attention was given to the improvement or selection of breeds, and after a time the deteriorated progeny of the early importations had multiplied to such an extent as to become a positive nuisance in some regions. Farm implements, aside from the few left by early voyagers, were not in use until 1825. Until this time the natives dug the earth with an oval instrument about 8 inches long called an "oo," which was set in a socket. Carts and wagons were introduced about the same time. It is recorded that the breaking of the soil for the first sugar plantation was done by natives dragging the plow.

By 1835 beginnings had been made in the development of many important agricultural industries. Sugar and coffee plantations were beginning to prove remunerative, cotton culture and manufacture were begun, and extensive plantings were made to wheat, potatoes, tobacco, etc.; silk culture had been introduced. As the production of these crops increased, the natural resources of the islands diminished. Exports of sandalwood, once a source of revenue, amounting to over $400,000, had fallen off to less than $30,000. In 1850 the principal agricultural exports of the islands were sugar, 324,042 pounds; molasses and sirup, 127,118 gallons; coffee, 150,000 pounds; Irish potatoes, 71,985 barrels; sweet potatoes, 10,837 barrels; oranges, 143,610; melons, 7,756; squashes, 51,769; swine, 696 head; fowls, 375 dozen; turkeys, 761; pineapples, 21,310; cocoanuts, 6,350; cabbages, 1,600 pounds, etc. At the present time most of these, except sugar and sirups, are imported, while the sugar exports have increased enormously. In addition to the exports in 1850, most of which went to California, the supplying of whaling vessels was a very considerable source of revenue, in one year more than 5,000 barrels of potatoes and 50,000 pumpkins being sold to vessels provisioning for their summer cruises.

In 1850 the Royal Hawaiian Agricultural Society was organized. The object of this society was to promote Hawaiian agriculture by the dissemination of information regarding new industries and the fostering and improvement of those already established; for the introduction of new and improved agricultural machinery; introduction of seeds and plants; improvement of breeds of horses, cattle, sheep, swine, poultry, etc., and for the consideration of the labor conditions of the islands. Agricultural surveys were to be made, statistics collected, experiments undertaken, individual effort encouraged in various ways, and annual exhibitions held at which premiums were to be granted for excellence in all lines of agriculture. In the report of the first exhibition, among the exhibits noted were "wheat, oats, sweet and

Irish potatoes, corn, cane, coffee, cacao, onions, carrots, beets, parsley, radishes, taro, peas, turnips, grapes, apples, peaches, pomegranates, melons, arrowroot, butter, eggs, etc.; and among stock, horses, cattle, sheep, and monstrous swine." Particular mention is made of the unusually fine quality of the wheat, corn, figs, pomegranates, carrots, radishes, turnips, and Irish potatoes. In the transactions of this society accounts are given of the beginnings of a number of industries. The first sugar plantation was established on a grant of land on the island of Mauai in 1835. From the first crop sirup or molasses alone was obtained, and prior to 1842 the quality of the sugar produced was very low. Between 1835 and 1840 two sugar mills were built and abandoned, and the first permanent mill was built in 1841. About this time a Frenchman named Prevost, who had lived upon the island of Bourbon and learned something of the sugar manufacture, was engaged upon the plantation. As a result of his experience, changes were made and the quality and value of the product was greatly enhanced. In 1850 there were three mills on Mauai, whose combined capacity was about 600 tons, the yield at that time being about 1 ton per acre. The production of sugar increased gradually, due to the importation of cooly and other labor, and to the hope of reciprocity with the United States. Reciprocity was secured in 1875, and the production of sugar was greatly increased, so that by 1890 more than eight times as much was manufactured than before reciprocal trade was established, and fully 96 per cent of all exports were sugar. This increase was secured by better methods of cultivation and by irrigation, so that a yield per acre of 10 or more tons of sugar is obtained. Much of the irrigation is by usual methods, but pumping stations and artesian wells supply their share of the water. The first artesian well was bored in 1879 and a second in 1880. They gave a large flow of water and were the beginning of extensive irrigation.

INTRODUCTION OF COFFEE AND RICE IN HAWAII.

Coffee introduction is generally attributed to Lord Byron, who is said to have brought plants from Rio Janeiro, Brazil, in 1825, although Marin, in his diary, says he planted coffee in 1817. The first plantation of any extent was made under the patronage of Governor Boki, in the Manoa Valley, in 1825. About the same time, or a little later than Lord Byron's importation, a Mr. Charlton, British consul at Honolulu, introduced a consignment of plants from Manila, which were planted in the above plantation, and are said to be the stock of much of the coffee grown in the islands. Plants were later brought from Batavia. The early experiments soon showed the possibility of coffee culture in the islands, and the industry spread widely, although certain districts seem to have been especially preferred. The industry flourished until 1856, when it received a serious check. Following the

rainless winter of 1855–1856 the well-known coccus, which is the forerunner of the coffee blight, made its appearance, and within a few years many of the plantations were ruined; the trees were dug out and cane planted where the situations were suitable. The disease seems to have disappeared in a few years, but the industry never regained its former importance, although as late as 1892 the legislature appropriated $10,000 for the encouragement of coffee culture. The area adapted to coffee is of much greater extent than that now planted, but with the declining price of coffee in the world's markets and the cost of Hawaiian production, the outlook for extension is not bright. So low has the price gone that many plantations have been abandoned, the cost of picking and cleaning being greater than the market price of coffee, leaving nothing for the investor.

Next to sugar the most important crop now grown for export in Hawaii is rice. The beginning of rice cultivation was made by a Mr. Holstein in 1858, and with the introduction of seed from South Carolina in 1860 the industry proved a decided success. In 1862 the exports of rice and paddy amounted to 920,000 pounds. The maximum exportation was reached in 1887, when 13,684,000 pounds were shipped from the islands. The production has decreased since that time, and the exports have fallen off more than half. A reason given for the diminution in rice production is the substitution of sugar cane as a crop in the lands which were easily drained. The growing of rice is wholly in Chinese hands, and five crops are produced in three years.

The yield is 1,500 to 2,000 pounds per crop per acre, worth 4 to 5 cents per pound. The methods followed in harvesting are crude, and by the introduction of modern machinery the cost of production could be materially lessened.

EARLY EFFORTS TO ESTABLISH AGRICULTURAL INDUSTRIES IN HAWAII.

At different times considerable effort has been expended in trying to develop other industries, such as wheat, tobacco, maize, silk culture, and cotton growing and manufacture, but nearly all have been abandoned in recent years. Wheat was planted by Marin in 1817, but little attention appears to have been given it until 1850, when 100 bushels are reported from the district of Hamakua, Maui. In 1854 there were reported in the same district 1,200 acres sown to wheat, the yield of which was estimated at 25 bushels per acre, and it is stated that 7,000 to 8,000 acres were adapted to that crop in Maui alone. Maize was introduced about the same time as wheat, and has had much the same history. It is especially subject to attacks of worms, and two or even more replantings are often necessary to secure anything like a stand. After flourishing for a while the industries languished, and in 1896 flour was imported to the value of $156,999. The growing of tobacco was once thought promising, and in 1852 a demonstration was made of

the possibility of its culture. A report upon the quality of cigars made from Hawaiian-grown tobacco says they were better in quality than two-thirds of those imported. This industry does not seem to have prospered to any great extent, and the present imports are in excess of $150,000. Cotton cultivation was begun and a mill erected about 1840, but beyond demonstrating the possibility of production little seems to have come of it. Silk culture was also begun and abandoned. Half a century ago Irish and sweet potatoes were extensively grown. For the year ending August 10, 1850, 26,421 barrels of Irish potatoes were shipped from one port to California, and more than 5,000 barrels were furnished to whalers during the same time. Sweet potatoes were a standard article of diet, and fifty varieties are named and described in the Transactions of the Agricultural Society. At the present time Irish potatoes are imported into Hawaii, the imports amounting to from 20,000 to 30,000 bushels, which are retailed at from 1½ to 4 cents per pound. In nearly every agricultural industry attempts have been made, and in some cases repeated and persisted in, to secure success, but failure seems to have been the common lot of all except sugar and rice.

WORK OF HAWAIIAN BUREAU OF AGRICULTURE AND SUGAR PLANTERS' ASSOCIATION.

In 1892 the legislature established a bureau of agriculture and forestry. This office was created to provide public lectures and to distribute information valuable to agriculturists, stock raisers, and others, to import plants and seeds, to compile statistics, to conduct cooperative experiments in agriculture, etc., the functions of the Royal Agricultural Society being practically absorbed. This bureau is still in existence, but from its reports its importations at present seem to be chiefly of ornamentals. The bureau began, shortly after its establishment, cooperative work with the Sugar Planters' Association on the study of noxious insects and means for their destruction. Prof. A. Koebele, of California, and formerly attached to the Division of Entomology of the Department of Agriculture, was secured to take charge of the investigations, which are still being pursued. Success has been achieved in a number of instances with the introduction of parasites of insects, particularly the ladybird parasites of scale insects. Australia, China, and Japan have been visited, and the parasites of injurious insects collected and successfully conveyed to Hawaii. The necessity for this work is found in the fact that the most injurious insects in the islands are not indigenous, but have been, for a great part, introduced from the countries named. Being of accidental introduction, their enemies were not brought with them. Unchecked by natural means, these insects spread with alarming rapidity, causing enormous losses; but from the beginnings made, the outlook for preventing further losses from this cause seems assured.

In 1895 the Sugar Planters' Association organized an experiment station for the investigation of the various problems concerned with the growing of cane and manufacture of sugar. This institution was of a private nature, conducted under the auspices of the Government but receiving no financial support from it. The staff consists of a director, two assistant chemists, and a field assistant. The station occupies laboratories within the city of Honolulu, and has an experimental field of 5 acres, and for larger field demonstrations cooperative work is done upon plantations adapted to the particular investigation at hand. The principal investigations have been made on soils, fertilizers, culture, variety experiments, and studies on the technology of sugar making. Extensive studies have been made on the origin of Hawaiian soils, which are derived to a great extent from decomposed lavas. Irrigation investigations have been undertaken, and it has been shown that in some instances three times as much water is put upon the soil as is needed for the maximum crop production. As much of the irrigation water is pumped from great depths by expensive machinery, and as fuel is very costly, the saving made possible by this one investigation is quite large. The introduction of improved varieties of cane has been highly valuable, and, as far as possible, attention is being turned to the testing of other plants adapted to the islands.

ESTABLISHMENT OF A FEDERAL EXPERIMENT STATION IN HAWAII, AND ITS WORK.

In the appropriation bill for the Department of Agriculture, which was approved May 25, 1900, the Fifty-sixth Congress set aside $10,000 for the establishment of an agricultural experiment station in Hawaii similar to those provided for by the Hatch Act for the other States and Territories. In pursuance of this act of Congress, Dr. W. C. Stubbs, director of the Louisiana agricultural experiment stations, was sent to Hawaii during the summer of 1900 to make a preliminary survey of the situation. Acting upon his recommendations, which were transmitted to Congress and published as House Doc. No. 368, Fifty-sixth Congress, second session, and afterwards as Bulletin No. 95 of the Office of Experiment Stations of this Department, Congress increased the appropriation, and directed the organization and equipment of the station under the supervision of the Secretary of Agriculture. Inasmuch as the experiment station of the Sugar Planters' Association would continue studying the problems connected with that industry, it was decided to devote the energies of the station to be established under the auspices of the Department of Agriculture chiefly to other agricultural industries. Among the subjects suggested to which attention should be given were the culture of fruits, vegetables, forage crops, coffee growing, stock raising, dairying, irrigation, and forestry.

By agreement between Dr. Stubbs and the local authorities the tract of land known as Kewalo-uka, adjoining the city of Honolulu, was recommended as a site for the station. This land had been set aside by former officials for experimental investigations, but had never been utilized. After the action of Congress immediate measures were taken to organize and equip the station. Accordingly, Mr. Jared G. Smith was transferred to the Office of Experiment Stations from the Section of Seed and Plant Introduction of the Department, and charged with the responsibility of beginning the work of the organization of the Hawaiian agricultural experiment station. Mr. Smith left Washington in March, 1901, and arrived at Honolulu early in April, and at once began active operations to carry out the desires of the Secretary of Agriculture. The tract of land set apart for the use of the station contains about 154 acres lying along the slopes of the Punchbowl and Tantalus Ridge. It is an irregular strip of land nearly 2 miles long and only a few hundred yards wide, and in some places the slope is so very steep as to almost prevent any kind of cultivation. The elevation ranges from 125 feet near the city to 1,350 feet at the other extreme. This variation in elevation is of advantage in giving different amounts of rainfall, and thus permitting varied experiments to be carried on. The lower portion of the station land was densely covered with a scrub of lantana, guava, algaroba, and cactus, while the upper part, once densely wooded, had been stripped and afterwards planted to eucalyptus. Twenty-four acres of the lower lying portion of the tract have been cleared and prepared for cultivation. On this area irrigation by pumping will have to be adopted for some of the investigations, as the rainfall is not sufficient to secure anything like maximum production. Of the timbered area, 13 acres have been cleared, terraced, and will be planted to horticultural crops, trees and bushes predominating; in this way the soil will again soon be covered. This is the only part of the station's grounds where irrigation will be unnecessary, the average rainfall, due to the greater elevation, being sufficient for all purposes. A number of buildings have been erected, among them a six-room residence for the director, an office and laboratory building, a stable, a laborers' house, and a poultry house. Large tanks have been built as water reservoirs and a pumping plant installed. A seed bed has been prepared and covered with slats for use in connection with experiments where a propagating house is needed. Experiments with poultry have been begun, as they are of immediate practical importance. Largely on account of the ravages of disease the supply of poultry is always inadequate. Live chickens sell for $12 to $18 per dozen, and eggs at 40 to 60 cents per dozen. Investigations thus far conducted have shown how, in a number of particulars, some of the diseases may be combated, and a bulletin has been issued concerning them. Cooperative experiments have been begun in studying the diseases

of potatoes and taro. The prevailing disease of the potato seems to be the potato rot, and should yield to the proper use of fungicides if the atmospheric conditions where potatoes are grown will admit of their use. The taro (*Colocasia antiquorum esculenta*) is the principal food plant of the native Hawaiians, and foreigners are said to soon acquire a liking for poi, the chief form in which the roots are used. In some parts of the islands the production has fallen off 50 to 90 per cent of normal. This seems due to a number of causes, the principal of which appear to be to faulty cultivation and probably a fungous disease. Cooperative experiments have been begun in rotation of crops and use of lime, and already it is believed some improvement has been secured. Plans are being matured for experiments in horticulture, especially in fruit growing. The market of the Hawaiian islands is largely supplied at all seasons with fruits and vegetables from California, which they can and should produce at home, and have a surplus to send to the mainland between seasons. Plantings have already been made of pistachia, grapes, peaches, and gooseberries, and others are contemplated. Studies will be undertaken in soils, forage crops, animal husbandry, and dairying as soon as funds will permit. An attempt was made to secure financial aid for the station from the Territorial legislature to supplement the sum appropriated by Congress, but no assistance was granted. A preliminary survey has been made of the coffee industry. The adaptability of the coffee tree to Hawaiian conditions has been long since demonstrated, and its extension over a widely increased area is shown possible, if the conditions warrant it. It is estimated that more than $10,000,000 have been invested in this industry, but with the world's supply increasing at a much more rapid rate than the increase in consumption, the price has been forced down below the actual cost of production in Hawaii.

The work of the station has thus far been organization and preliminary investigation. With this work largely completed, the problem of restoring some of the decadent industries will be taken up, the hope being that the small farmer will be again a prominent component of Hawaiian agriculture. Improved methods will reduce the cost of production, so that a comfortable living may be gained by the man owning a small tract of land. The old system of land tenures was opposed to agricultural development. For a long time the idea of individual ownership of land was unknown, and only life tenures were allowed to the natives, and foreigners could occupy land only at the pleasure of the chiefs. The land laws have undergone radical change, but through a number of agencies large holdings of agricultural land are the rule. The improvement of Hawaiian agriculture does not depend so much on what crops will flourish in the islands as on economic questions, prominent among which are markets, transportation, and labor.

The returns of the Census of 1900 gave the population of the Hawaiian group at 154,000. In 1896, 60 per cent of the population consisted of Portuguese, Chinese, and Japanese, most of whom were brought to the islands to labor on the sugar plantations. With this vast preponderance of labor and a ready market secured with the United States, sugar dominates everything in the islands and pays large profits on the investments. If coolie labor is restricted, the demand for laborers will be increased and the wages paid upon the sugar plantations will make the standard for the whole Territory. So long as current prices for sugar prevail it is probable that agriculture on an extensive scale, except with sugar, can not be made remunerative. The home market is comparatively limited and soon supplied, and the difficulties of inter-island transportation are such that little profit is left to the producer upon shipments made to Honolulu. Should the world's production of sugar so increase as to result in a fall in price, and a corresponding reduction in the margin of profit, general farming may once more become remunerative. In the meantime, attention can be given to supplying the home market and to the cultivation of crops which, while not competing with those produced in the United States, are in sufficient demand to make their production advantageous.

INVESTIGATIONS IN THE PHILIPPINES.

SOIL AND CLIMATE.

Agriculture in the Philippines has not prospered as would have been expected in a country possessing such fertile soil and diversified climate. Nearly every known type of soil can be found somewhere in the archipelago, and the climate varies within wide limits. Full meteorological records have been kept for nearly forty years at the University of Manila. From 1865 to 1880 six daily observations were made, while beginning in 1880 hourly observations were taken from 5 a. m. to 11 p. m., and beginning with 1883 hourly records have been kept. An average annual temperature of 79.2° F. is reported for Manila with a variation of 3.2° in the monthly averages. The highest temperature reported during the period from 1883 to 1899 was 100° F. on May 23, 1889. The lowest temperature observed for the same period was 60.2°, giving 40° as the extreme fluctuation of the thermometer. Observations made at a number of other localities showed wider variation. The average rainfall at Manila amounts to nearly 80 inches, 20 per cent of which falls between November and May, the so-called dry season. On the eastern coast of Mindanao, at Fandag, during 1897, the rainfall was 169.2 inches. In the interior of the larger islands, and especially upon the eastern coast of Luzon, the rainfall is much less than elsewhere. The range of temperature increases in a somewhat similar manner and lower temperatures are experienced at increased elevations

from sea level. In the province of Benguet the climate becomes quite temperate, due to its elevation and exposure, the hottest temperature rarely exceeding 70°, and ice has been formed on the coldest nights.

PRESENT AGRICULTURAL CONDITIONS IN THE PHILIPPINES.

Attempts have been made at some time to introduce into the islands nearly every important agricultural industry of tropical or temperate climates. After flourishing for a time many have been almost wholly abandoned. There are a few staple crops which are grown to a considerable extent, but of such an important crop as rice, the bread of the islands, not enough is grown to supply the local demands. The growing of this crop is better understood than any other, yet by the primitive methods of culture and crude machines for cleaning the crop, not enough is produced to supply the local demand, and during the past fiscal year more than 390,000,000 pounds, valued at $5,409,958, were imported. Ordinary vegetables, where grown, are poor in quality and small in size. Live stock appear to be of inferior grades, which are seemingly degenerated from better stock.

Numerous reasons have been assigned for the limited development and retrogression in agriculture. The native people seem to possess little ambition and are content when their wants for the immediate future are supplied. They grow a little rice, plant a few sweet potatoes, which grow and spread indefinitely, and for their other rather limited necessities they depend to a great degree upon the natural products of the forest and sea. As has been mentioned above, the methods of cultivation are primitive and inefficient. Rice is now grown and harvested in practically the same manner as a century or more ago. It is hulled by pounding in mortars and winnowed by tossing in baskets. Modern implements are unknown or seldom used where they have been introduced. But little is known regarding the proper cultivation of crops, and the varieties grown are not always of the best quality or most prolific in production. Aside from the so-called manila hemp and possibly the banana, the important agricultural products of the islands are of crops the cultivation of which was introduced by the Spanish.

A serious drawback to agricultural development is the lack of suitable or in some cases of any means of transportation. Highways and railroads are woefully inadequate, and the marketing of produce is in some regions an absolute impossibility. In many sections trails are the only paths of travel and buffalo carts and peons the only means of conveyance. Without marketing facilities there is little incentive to the growing of bulky crops. In some localities irrigation waters are abundant, but little or no attempt has been made to utilize them, and dependence is placed wholly upon the rains. Droughts are of frequent occurrence, and much suffering and loss that could be easily prevented

are occasioned by them. Again, the agricultural development is seriously impeded by a lack of capital and the often defective titles to land. These bear especially heavy upon the small farmer, who can never obtain loans at as low rates or on as favorable terms as the owner of a large estate.

EFFORTS FOR IMPROVEMENT OF AGRICULTURAL CONDITIONS IN THE PHILIPPINES PREVIOUS TO AMERICAN OCCUPATION.

Various attempts have been made to develop the agricultural resources of the islands. In 1782 a monopoly of tobacco, the cultivation of which had been introduced in the latter part of the sixteenth century, was decreed in several provinces, and a forced cultivation of that crop was attempted. No tobacco was allowed to be grown except on the island of Luzon, and in only a few districts upon that island. Other provinces produced tobacco in considerable quantity, but it had to be disposed of clandestinely. Under the tobacco monopoly compulsory labor was authorized, and natives desiring to cultivate the soil were compelled to give preference to tobacco to the exclusion of other crops, even of food stuffs. Each family was required to raise 4,000 tobacco plants, or suffer a fine, and the entire crop had to be delivered to the Government, the grower not being allowed any for his own use. Uncultivated lands were appropriated by the Government and assigned to individuals, and all former tenants were dispossessed. The enforcement of these burdensome regulations was the cause of much trouble, and led to the riots in Ilocos of 1807 and 1814. After a time the Government farmed out the various monopolies, but either under private or governmental control the monopoly in tobacco was continued for more than a century. In 1882 the monopoly was abolished, and the exportations were nearly doubled in ten years. With a better knowledge of the cultivation and handling of this crop it is capable of still greater extension.

In 1785 the Real Compañia de Filipinas was chartered by royal decree, giving it almost absolute control of the mercantile affairs of the archipelago, in return for which the company was required to expend 4 per cent of its net income upon the development of the agricultural resources of the islands. Stimulated by the large amount of money expended, and the prospect of more to come, many enterprises were begun, which flourished for a time. Sugar, coffee, and tobacco plantations were extended on all sides. Indigo, silk, cotton, cocoa, condiments (pepper, cinnamon, allspice, cloves, etc.) were produced in considerable quantities, and their production seemed well established. This company was a semiofficial one, one-fifth of the shares being retained by the King and the clergy, and favoritism rather than worth seems to have been rewarded in the management of its affairs. Lack of technical knowledge of the industries, opposition on the part of the

merchants of Manila, and special concessions granted to the city and merchants of Acapulco, Mexico, as well as special privileges assumed by many provincial governors, led to the downfall of the company, and in 1830 the commerce of Manila was open to the world. Special concessions were still granted to companies and individuals of nearly all nations, but failure seemed to overtake them all sooner or later. The industries which were stimulated by the bounties given them flourished for a while, but have retrograded until some that were seemingly very promising have become of little consequence. Notably is this true of the production of rubber, indigo, cotton, silk, and condiments. A conspicuous factor in the many failures to improve the agricultural condition of the islands has been the indifference of the natives. To engage regularly in any pursuit too much labor is required, and to supply the necessities of life the abaca, or manila hemp, is resorted to. This is widely produced, and it requires comparatively little labor to extract a few pounds of the fibre. There is always a demand for it; it is purchased in any amount, is easily brought to market, and a few pounds will supply the most urgent necessities of the seller. The production of manila hemp is one of the agricultural industries that does not seem to retrograde, the area devoted to it being constantly increased, and it furnishes one of the principal exports of the islands.

But little seems to have been directly done by the Spanish Government to improve the condition of agriculture or the agriculturist until late in the nineteenth century. Following the agitation in Europe and America for agricultural instruction, there was organized November 15, 1881, an agricultural society, which was for a time treated as an adjunct to the department of forest inspection. These institutions were separated by royal decree, dated July 8, 1884, and the agricultural department was made independent and placed under the control of an agricultural commission, which was charged with the reorganization and regulation of the department. The regulations promulgated provided for the study of agriculture, animal production, and the means for their improvement, theoretical and practical teaching of agriculture and animal husbandry, preparation of reports and editing monographs relating to the agriculture of the archipelago, and the preparation and care of agricultural museums.

By royal decree of November 26, 1887, there was ordered the creation, at Manila, of a school of agriculture, whose object was to be the theoretical and practical education of skilled farmers and overseers and the promotion of agricultural development in the Philippines by means of observation, experiment, and investigation. This school was opened July 2, 1889. In addition to this institution, courses in agriculture were given at the University of Manila and at the Municipal Athenæum. By the law establishing the school of agriculture, instruction was required to be given and experimental work performed by

the students in the study and analysis of soils, irrigation, seeds, methods of cultivation, testing new crops, meteorology as related to agriculture, cost of crop production, animal husbandry, diseases of plants and animals and means for their repression, agricultural machinery, etc. In addition to agricultural colleges, experimental stations and farms were established. The laws under which they were conducted required that the directors and professors should be agricultural engineers, with skilled graduated farmers for their assistants. In 1888, according to Foreman, "the budget provided the sum of $113,686.64 for a school of agriculture in Manila and ten model farms and schools of cultivation in the provinces. * * * Instead of benefiting the colony, this sum goes to furnish salaries to needy Spaniards." Judging from the published results, the testimony before the Philippine Commission, and the accounts of travelers, the plan as set forth in the scheme of organization was far from realized. One witness, who had taken the agricultural course in Manila, was quite severe in his remarks concerning the institution. Nothing practical was attempted; only the theoretical teaching of the practices in Spain and other parts of Europe was offered. Little seems to have been done or attempted to study the agriculture of the islands or to improve it. The land which was provided for agricultural experiments was devoted to vegetable and flower gardens, the produce of which was enjoyed by the officers. The study of the cultivation of hemp, cane, indigo, or the improvement of cattle, all of which were provided for in the organic act, was ignored. When special conditions, such as the appearance of glanders among the horses and mules, and the outbreak of the coffee disease, required that some attention be given them, commissions were formed for their study, but no reports were made until the diseases had run their course and the destruction was complete. The execution of what appears to have been intended as a beneficent act was evidently intrusted to individuals who were incompetent, to say the least.

In 1887 the first experiment station or model farm in the archipelago was established at La Carlota, Negros, near the principal center of agricultural activity in the islands. A short time after a second station was located at San Pedro de Magalang, on the island of Luzon. After 1888 this station paid special attention to horse breeding, a stud of Arabian horses being kept for crossing with the smaller horses of the islands. Other stations were maintained in the provinces of Albay, Isabela, Luzon, Iloilo, Ilocos Sur, and Cebu. Stations were also established in Jolo and Leyte, but were discontinued after a short time. These institutions were designed to show what crops and methods of cultivation could be best maintained in their vicinity, and they were permitted to receive a limited number of students who were trained for overseers of large plantations. In 1894 there was established an official monthly publication of the stations called the Boletin Oficial

Agricola de Filipinas, which was designed to record the various investigations conducted at the agricultural schools and stations. The few copies of this journal which have been seen are filled with translations and accounts of agriculture in foreign countries, with little mention of that of the Philippines.

WORK OF THE UNITED STATES COMMISSION IN THE PHILIPPINES.

With the American occupation of these islands the operations of these institutions were suspended, but the present Philippine Commission is alive to the importance of agricultural investigations, as is shown by a perusal of the reports and acts which have been published. One of the early acts of the Commission was the authorization of the expenditure of $2,000,000 for the repair and construction of highways and bridges in different parts of the islands. This sum has been augmented by additional appropriations from time to time. All reports published have shown that road construction must precede any improvement in the condition of agriculture. In August of the past year a loan of $25,000 to each of the provinces of Capiz, Ambos Camarines, and Iloilo was made, to be used in road construction. The immediate object of this loan was to give employment to the people of those provinces, who were suffering from a shortage in the rice supply. The deficiency in the rice production was attributed to an outbreak of rinderpest in the islands whereby 80 per cent of the carabao, or water buffalo, were destroyed. A bureau of statistics and a weather bureau have been established, both of which will ultimately be of great value to the agriculture of the islands. The weather bureau, as established, consists of a central station at Manila, 9 stations of the first class, 25 second class, 17 third class, and 20 special stations for rain observation only. The efficiency of the former meteorological station in forecasting storms has been demonstrated many times, and with the wider field of observations its usefulness will be increased.

One of the most important acts of the Commission has been the reorganization of the bureau of forestry. At first, this bureau was under the direction of an officer detailed from the army service, but on July 16, 1901, a permanent organization was effected, with a salaried chief, assistant chief, and a corps of foresters, inspectors, rangers, botanists, collectors, clerks, etc. The public forests are estimated at nearly half the entire area of the islands, or at from 20,000,000 to 40,000,000 acres. Under the Spanish law which governed the cutting of timber it was the practice to sell the timber at a fixed price per cubic foot. At present a license must be secured to cut timber and payment made for the timber removed according to the quality. The timber trees of the islands have been classified for cutting purposes into six groups, and the price for timber in all the islands is from 1 cent to 14 cents per cubic foot, dependent upon the group. Cutting for

fuel is not permitted except in the three lowest classes. The revenue derived during the first year of American management greatly exceeded that reported by the Spanish authorities, and the chief of the bureau has estimated an annual revenue of more than $1,000,000 when the forests are properly exploited.

For the study of the causes, pathology, and methods of diagnosing and combating the diseases of man and animals, a biological laboratory has been established at Manila, as well as a laboratory of chemistry and laboratories for the production of vaccine virus and of various serums and prophylactics, and all biological and chemical investigations of the Government are intrusted for the present to them. In order to secure the proper correlation of work, the department of the interior was organized September 6, 1901, and made to embrace the bureaus of foresty, agriculture, weather, public lands, government laboratories, etc.

The most important step of all, from an agricultural standpoint, was the establishment of the bureau of agriculture on October 8, 1901. Prior to this time the reestablishment of the agricultural school near La Carlota, on the island of Negros, was decreed, and $15,000 was appropriated to carry out the intentions of the commission; $1,000 was also appropriated to carry on experimental work in agriculture at Granja, Negros, the idea being to incorporate the experimental farm with the agricultural college. The recently established bureau of agriculture is charged with the investigation and dissemination of useful information with reference to the agricultural resources of the Philippine Islands; the methods of cultivation now in vogue and their improvement; the practicability of introducing new and valuable agricultural products; the introduction of new domesticated animals, and the improvement of the breeds of domesticated animals now found in the islands; and shall, in general, seek to promote the development of the agricultural resources of the archipelago. The bureau is charged with the control of the Government farm at Magalang and La Carlota, and of the Government experiment stations in the provinces of Iloilo, Cebu, Isabela, Ilocos, and Albay. The organization of the bureau is to follow as nearly as may be the lines adopted by the United States Department of Agriculture. The Philippine Commission, through the Secretary of War, invited the Secretary of Agriculture to nominate a suitable candidate for the head of this new bureau, and Prof. F. Lamson-Scribner, for nearly eight years Agrostologist of this Department, was designated, and has been appointed to the position of chief of the insular bureau of agriculture. The new chief expects to take up his work in Manila early in the coming summer, and considering the field for research and economic work, this bureau should develop into one of the strongest and most influential for the good of the country of any already established or yet to be provided.

Some perplexing problems will have to be solved to bring the agriculture of the islands to the condition of prosperity of which it is evidently susceptible. An apparently indifferent people must be aroused and made to see it is to their interest to adopt progressive methods of cultivation. The problem is not what to grow, but where and how. Studies should be made of the adaptability of plants to soil and climate, of methods of handling crops, of marketing, of stock feeding, of protection of stock and crops from losses by disease, etc. The reestablishment of some of the now abandoned and forgotten industries may be well considered. The utilization of the natural products of the country should be urged, since they are in many instances unique, and would have, almost unopposed, the markets of the world. Java has been made a rich, prosperous, and contented country by the Dutch, and there appears no good reason why the same should not be done for the Philippines.

MOUNTAIN ROADS AS A SOURCE OF REVENUE.

By James W. Abbott,
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INTRODUCTION.

It is the purpose of the present paper to consider the road question from a point of view which the writer believes to be not only vastly important, especially to the mountain region which he represents, but entirely new in the discussion.

The numerous and capable advocates of good roads throughout the country, and the many associations devoted to road improvement, have given to the economic and industrial side of the question the fullest consideration, while the interest in good roads of those seeking health and recreation has not been forgotten. The intelligent work of the Office of Public Road Inquiries of the Department of Agriculture has been particularly directed to disseminating information upon the costliness of bad roads, the economic benefits to all classes of the community of good roads, and the best methods and materials for road building. The writer's object here, however, is to approach the question from a standpoint which in the highest degree unites the utilitarian and the æsthetic ideas. While applicable to very many sections of the country, this consideration of the question seems especially pertinent to the mountain region of the United States, extending practically from the Canadian border on the north to the Mexican border on the south, and from the Upper Missouri River to the fertile plains and valleys of the Pacific coast. It may be said without exaggeration that in no other part of the world is there to be found so vast a region containing throughout its entire extent scenic features of such unsurpassed beauty, with every variation of climate, affording hygienic conditions adapted in the highest degree to both recreation and health for every conceivable class of persons, healthy or invalid. The railroad facilities by which this region is reached and traversed afford the acme of traveling convenience and luxury. No political boundaries with the unpleasant concomitants of custom-house officers and passport inspection here confront the traveler in search of health or pleasure or business; each one exercises that absolute freedom of movement so inseparable from true enjoyment—free from the interference of government control, police surveillance, or the arbitrary and utterly

unwarranted exactions of petty officials which so frequently vex the traveler in Europe.

Considering the annual influx of travel invading all those regions of Europe famed for their scenic and climatic attractions, an amount of travel greatly augmented by contributions from the United States, it seems marvelous indeed that more of it has not been diverted into our mountain regions. Unfortunately, a very little consideration of the matter readily reveals the explanation of this state of things. Excepting in a few more or less widely separated localities, the roads are very primitive and the places of entertainment execrable, compared with the European standard, where these facilities make the valuable attractions of foreign countries most agreeably accessible.

It seems too obvious for argument that the pecuniary results to the communities occupying this highly favored region from securing a liberal share of patronage from tourists and travelers, seekers of health, recreation, or information, would be fully equal in the course of a few years to those now enjoyed in those regions of Europe similarly favored in the way of scenery and climate if these communities should follow the example of their European brethren, who long ago discovered that the very best investment they could make for future and permanent profit was in the establishment of good roads which would penetrate every section of their country and make all its attractions accessible to visitors.

With a view to forcibly presenting this side of the subject to readers of the Yearbook, the writer, with the authority and approval of the Secretary of Agriculture and the Director of the Office of Public Road Inquiries, procured, through the courtesy of the State Department, from many United States consular officers in Europe replies to interrogatories designed to set forth the extent to which road building had been carried and the profits derived therefrom by the communities building them in those portions of Europe now so liberally patronized by the travelers and tourists of the entire world.

Edward C. Cramer, consul at Florence, Italy; Edward H. Ozmun, consul at Stuttgart, Germany; Horace W. Metcalf, consul at Newcastle-upon-Tyne; John Stalker, consular agent at Galashiels, Scotland; and William W. Touvelle, consul at Belfast, Ireland, all send interesting, instructive, and highly valuable reports confirmatory of those quoted in this paper, but which, for lack of space, can not be more than generally acknowledged. Mr. Touvelle estimates the cost of constructing an 18-foot wide macadam road in Ireland at about $5,000 per mile and of its maintenance at about $100 per annum.

SCENIC ATTRACTIONS OF THE OLD WORLD.

SWITZERLAND.

Henry H. Morgan, United States consul at Aarau, Switzerland, says:

By some authorities it has been estimated that the 3,000,000 tourists who yearly visit the country will leave, on an average, 20 francs ($4) each, making a total of 60,000,000 francs ($12,000,000), and by other authorities the amount is estimated at from 80 francs to 100 francs ($16 to $20) each, which would seem to be a far more correct estimate, for in a number of the more frequented resorts, like Lucerne, Interlaken, Geneva, etc., the highest estimate is far below what, in my opinion, is spent by the average tourist.

In Switzerland it is the barren rocks and the ice-clad peaks of the mountains to which the nation, to a very large extent, owes its wealth and prosperity; and, on the other hand, no other country has done so much to develop the so-called tourist industry by making accessible the mountains, valleys, gorges, and crevasses, regardless of difficulties and expense, and by establishing numerous fine hotels, offering all the commodities and comforts of modern life, no matter how near to the region of eternal ice or how far removed from the great arteries of travel the hotel may be situated, thus inducing the tourist who comes for the purpose of seeing the beauties of the Alps to prolong his stay.

Now that the funicular railway has made many of the high peaks of the Alps accessible, they are crowded every day by hundreds of tourists, and the monetary value derived from the natural and scenic conditions made available by the different mountain railways can be imagined from the fact that during the season just passed over 4,700,000 passengers traveled over these lines.

Besides these easily accessible resorts, frequented by all the excursionists and tourists, there are a great number of magnificent high valleys and Alpine health resorts situated far from the general travel, but connected with it by good roads, and only owing to such roads have they been made accessible and profitable.

* * * Parts of the country, still without railway connection, are accessible by a system of fine Alpine roads, and in the more remote parts by paths branching off from these roads. In addition, there are innumerable roads and footpaths intersecting each other between every village and town over every part of the Republic.

Mr. Morgan quotes from the Hotel Budget some figures regarding a large hotel in the Bernese Alps, 19 miles from the railroad, which has accommodations for 550 visitors, the total number during the season (from June 15 to September 15) being about 13,000, with a total rough income for the season of about $100,000. He further says:

When it is considered that this establishment, during the season, gives food, lodging, and wages to 250 employees, the monetary value of several hundred similar establishments in Switzerland, many of them open all the year, will be found to be an enormous one.

All the hotels have fine shops connected with them, which do a thriving business, and the receipts of the branches established at such resorts by the post and telegraph department form a very considerable revenue to the country.

The Swiss Government has organized a very good service of diligences which is kept up all the year round on the great first-class Alpine roads, as long as the large, enormous masses of snow and the danger of avalanches does not render this travel impossible.

Bridle paths and trails are numerous. There are Alpine societies which make it their object to make accessible all the points of view and all such mountains offering fine scenery. All the municipal authorities of towns and villages, anxious to attract

tourists, do a great deal toward building paths for pedestrians, and the National Government makes a certain appropriation each year for the maintenance of mountain roads in several cantons. All the inhabitants interested in the tourist industry form societies and contribute to the necessary fund. The Alpine societies of the different countries—Switzerland, Germany, France, and Austria—build paths and shelter houses for the protection of Alpine sportsmen. A great number of such shelters are established in the highest regions.

How capital is made out of scenic beauty in Switzerland is shown by the example of the great gorge of the Aare, near Meiringen. This most picturesque and grand gorge, pierced by the floods of the river Aare through an enormous mass of solid rock, was not accessible until lately, when it was made so by means of an iron gallery leading through its entire length. This gallery was constructed by a stock company, which has rented the gorge from the municipality of Meiringen, and now does great business by levying 1 franc from all tourists who come to see this celebrated gorge.

A. L. Frankenthal, United States consul at Berne, writes of the inducements offered tourists in Switzerland and the benefits derived from them by the whole country. He gives the following statistics: General information bureaus, 50; registered hotels in 1900, exclusive of those charging less than $1 per day, about 1,900; insurance on hotels in 1899, $107,000,000; available hotel beds, 104,876; hotel employees, 27,700, receiving in wages yearly, $4,000,000; visitors to registered hotels, 2,559,000; amount received by industries supported by tourists, about $40,000,000. Mr. Frankenthal further says: "No estimate could be made of the total amount of money spent by tourists; even if an exceedingly small sum per person is taken, the result in figures would show a surprising amount."

Horace Lee Washington, United States consul at Geneva, Switzerland, gives a large amount of interesting and valuable statistics, among which, perhaps, the most suggestive are: "In 1899, 158,000 visitors boarded in the hotels; in 1900, 175,000; and in 1901, approximately, 305,000." He also gives quite exhaustive details regarding the character and methods of construction and maintenance of the roads in the Canton of Geneva, which are of the very highest standard of mountain-road construction practiced in the world.

NORWAY.

Victor E. Nelson, United States consul at Bergen, Norway, says:

The present income derived from tourists during the season, in the period May 15 to September 15, has been estimated at about 10,000,000 kroner ($2,680,000), which sum at a rate of 5 per cent per annum represents the interest on a capital of 200,000,000 kroner ($53,600,000). That capital should therefore be the monetary value of the natural hygienic and scenic conditions at present. But I believe that the income yearly could be increased to about 40,000,000 to 50,000,000 kroner ($10,720,000 to $13,400,000) if the natural scenic and hygienic conditions were all made available by good roads, hotels, and mountain resorts and proper means of transportation. These 40,000,000 to 50,000,000 kroner would represent the interest on a capital of 1,000,000,000 kroner, which would constitute the monetary value of the natural hygienic and scenic conditions of Norway. The total number of tourists this year is presumed to be 30,000, of which about 2,000 were Americans.

Henry Bordewich, United States consul-general at Christiania, writes of the costly roads which extend far up into the Arctic Circle, and which are a source of interest and importance to travelers second to no other feature of weird and picturesque Norway.

AUSTRIA.

Frank W. Mahin, United States consul at Reichenberg, Austria, says:

This consular district covers about 8,000 square miles, approximately the area of the State of Massachusetts. It is nearly all mountainous. The summer resorts are numerous in the northwestern part of the district, comprising about one-quarter thereof. The only avenues of passage are wagon roads and footpaths, and often only the latter. There the very existence of the resorts and wayside hotels, which are many, depends upon good wagon and pedestrian thoroughfares.

The two most frequented modern resorts of this district are without railroads. In one case the nearest station is 3 miles and the other 10 miles. These resorts are made accessible by macadamized roads and well-kept footpaths, which radiate in every direction. The season is practically limited to the summer months, though there are occasional visitors in the spring and autumn. The resort, which is but 3 miles from a railway station, receives each season 30,000 to 40,000 transient visitors, although it has an all-the-year-round population of scarcely 300; the income each season is approximately 1,000,000 crowns ($200,000). This is a health resort, the water being a specific for nervous disorders, but transient guests go thither for the cool weather and charming scenery. All through this region is a very tangle of footpaths, crisscrossing in every direction, but all marked by different colors on trees and stones corresponding to colors on the maps which guide the pedestrian. Wagon roads being an exception here, hotels are found at frequent intervals on the paths; hundreds, and in July thousands, of pedestrians throng these ways.

The primary causes of the mountain resorts and hotels are natural scenic and hygienic conditions, but an absolute necessity to their existence are good roads and paths. These roads are all built with the greatest care, macadamized with basalt; their edges are protected with stones 3 or 4 feet high and 3 to 6 feet apart, the distance being less alongside a river or high precipice. Iron railings connecting the posts are sometimes used. Men are employed to keep the roads in good condition, each man being assigned about 1½ miles of road. A fresh layer of broken stone is put down every fall or spring, the mud being first cleaned off.

FRANCE.

Another phase of the road question, more or less touched upon by the other consuls, but not quoted for lack of space, appears in the following from Robert P. Skinner, United States consul-general at Marseilles, France:

The importance of maintaining first-class highways is as definitely accepted in this country as the multiplication table. A road map of France is not unlike a cobweb, or rather a series of cobwebs, each one consisting of concentric circles connected by radiating lines.

Within recent years a splendid road has been finished between Toblach and the Austrian frontier, where I believe it is carried on by the Italian Government to Venice. The military problem is responsible for this highway, but its more immediate effect has been to attract to the region thousands of tourists, who, until recently, did not go to Cortina at all, and could not go now except for this one road. Diligences and automobile omnibuses take the places of railways elsewhere, and Cortina, with a population of 800, has a summer population of from 5,000 to 8,000. The

coming of these thousands of strangers has brought prosperity to the agricultural classes, who now have a market for all sorts of perishable produce for which their fertile valley is adapted, and for which they would be unable to secure transportation to the markets of the larger cities. At midday from June to October one can see a line of private post carriages, diligences, and automobiles at Cortina a mile long, while the horses are being tended in neighboring stables. A school of marquetry has been established and gives employment to a large portion of the permanent population, and the output is all absorbed by the summer visitors. This is the most serious business carried on at Cortina, but there are, as may be supposed, hundreds of small shops where every conceivable trifle is offered for sale.

Between the city of Marseille and Toulon, connected by the finest railway in France, a number of "massagerie" firms do a large highway express business, and meet railway competition, both as respects expedition and prices. Now that the automobile has been perfected, in a measure, immense automobile trucks are being used for this traffic, and, because of the splendid roads, are able to travel at from 15 to 30 miles an hour. People find it now both easy and fascinating to make weekly excursions into the country, and, owning vehicles which enable them to extend their explorations to remote regions inaccessible by railway, they are gaining a vast fund of practical information which may be expected to favorably affect the development of the country in coming years.

The almost universal practice in this country is to employ two-wheeled carts for heavy traffic. French law does not permit more than five horses to be harnessed together, single file, in these carts, and the usual number is four. A team of four horses is always expected to transport 5 tons of merchandise, day in and day out. There are carters who work up to 8 tons and a good many who average 6 tons.

Very little improvement has been made in this country upon the Scotch system, of which the popular understanding, followed by the contractors here, is that the crushed stones must be equal in size, and none larger than a man could put into his mouth. Where this rule has been departed from, and especially where large stones have been mixed with small, the results have always been unsatisfactory.

The Axenstrasse road in Switzerland and the road from Salerno to Amalfi in southern Italy, types of roads in European mountain regions especially interesting to tourists, are shown in Pl. LXXII.

SCENIC ATTRACTIONS OF THE UNITED STATES.

No fact is better understood or more confidently relied upon in the scenic regions of Europe than the patronage derived every year from Americans. It is a subject which has excited much attention and discussion on this side of the Atlantic. The assertion is often made that it is a disgraceful thing that millions upon millions of American dollars should be squandered in Norway and the Alps by people ignorant of the overshadowing attractions of their native land. While all true Americans would rejoice to see the tide of travel turned toward this country, it behooves us not to belittle the allurements of European regions. We should concern ourselves diligently with the questions:

What are the scenic attractions of the United States?

How easy or how difficult is it to reach the various parts of the scenic regions?

What can be done to make the scenic regions most available, and what sort of expenditure in this line is most promising of results?

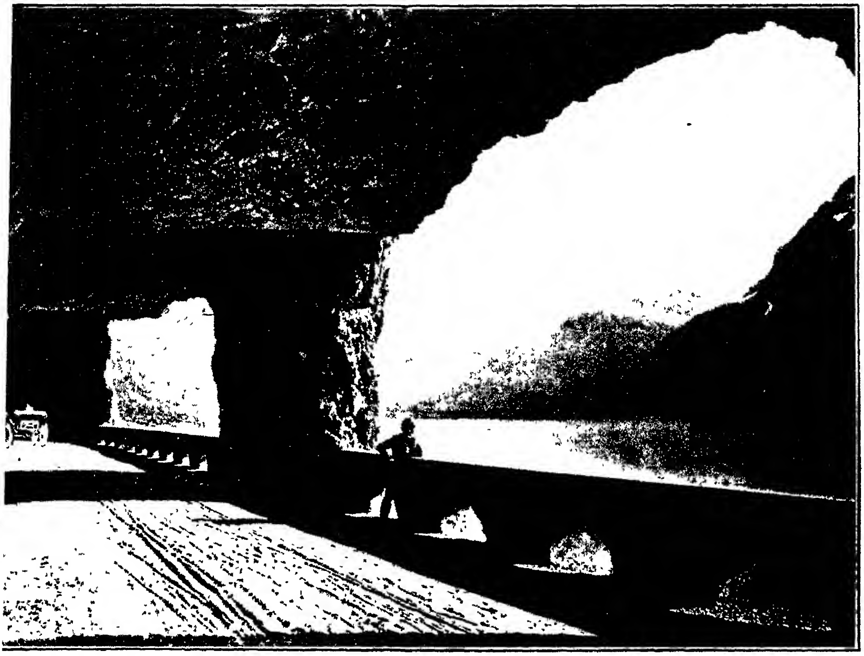

FIG. 1.—THE AXENSTRASSE ROAD, SWITZERLAND.

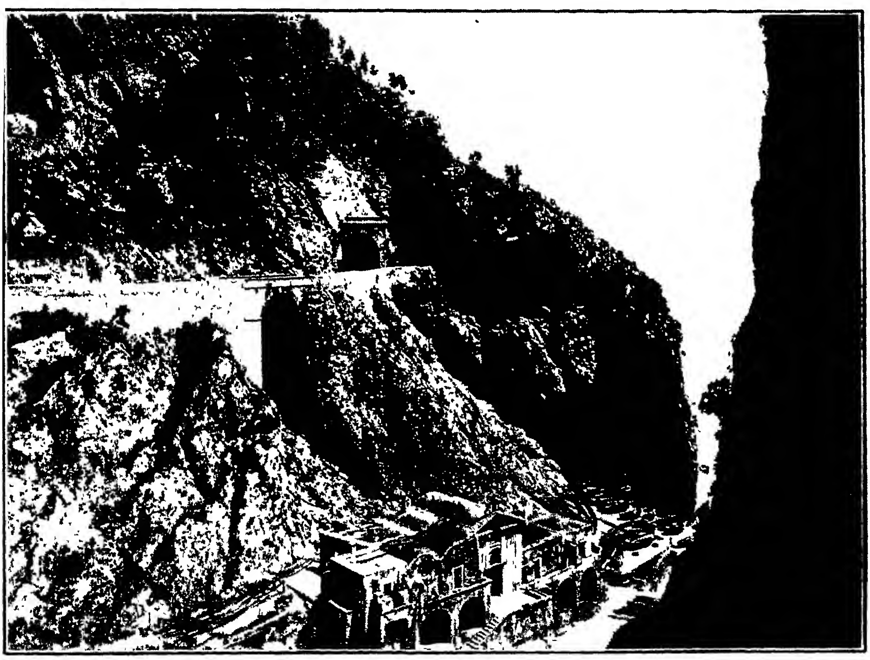

FIG. 2.—ROAD FROM SALERNO TO AMALFI, ITALY.

A GLACIER NEAR LAKE McDONALD, MONTANA.

EASTERN SCENIC REGIONS.

East of the Missouri River these questions have been quite satisfactorily and creditably answered. The very best which Europe has to offer already has its counterpart, in so far as that is physically possible, on our Atlantic seaboard and among the lakes, hills, and mountains of the East. In dozens of places on the coast, the White Mountains, Catskills, Adirondacks, Appalachians, and Alleghenies, tourists can find just as much of pleasure and comfort as they could in similar localities abroad. That they appreciate it is attested by the hundreds of thousands of patrons who each year avail themselves of these privileges. And this patronage is by no means confined to Americans. The love of travel and change is inherent in Europeans also, and they come each year in increasing numbers to gratify it in this country. Even as far west as the Hot Springs of Arkansas, in the beautiful Ozark Mountains, there has grown up a resort with every comfort and luxury to be found at Ems or Carlsbad.

WESTERN SCENIC REGIONS.

This paper has to do principally with the vast section west of the Missouri River, which contains practically 1,000,000 square miles of mountains. For comparison it may be noted that the entire State of New York covers a little over 49,000 square miles. As may be expected, the physical characteristics of so large a region vary greatly. Its mountain system seems to culminate in Colorado, where the large majority of its highest and most rugged peaks are found.

Here there is no parallel to Mont Blanc, the highest peak in Europe, which attains an elevation of 15,780 feet. Its American counterpart, Sierra Blanca, 14,390 feet, in Colorado, guards the southern flank, and Mount Rainier, 14,526 feet, in Washington, guards the northern flank of this great mountain phalanx; while in advance, as if leading in majestic march to the western ocean, stands Mount Whitney, 14,898 feet. It is an interesting feature of nature's plan that this is the loftiest trio of peaks in the United States. Between these north and south extremes there are perhaps a hundred as high or higher than the famous Jungfrau, in Switzerland, 13,670 feet.

Timber grows to a height of 12,000 feet in places in Colorado, while on Mount Shasta, in California (14,380 feet), it ceases at about 8,000 feet, and on Mount Rainier at 7,000 feet. In the Harz Mountains, in Germany, little timber grows above 3,500 feet, and in the Tyrolese and Bavarian Alps the limit is about 6,000 feet.

All realistic, vivid writers on scenic Europe say much about the play of light upon the snow and ice and the things which it conjures up in the imagination; and Alpine literature is filled with incidents of disaster and death.

Of glaciers, those awful, moving, frozen rivers of the Alps, none is found here to compare in frightful detail and tragic story. The tourists

can not be shown a yawning crevasse and told that "at this spot in 1820 three guides were swept in by an avalanche and carried down to unknown depths; that forty-one years later, fulfilling the prediction which said, 'About 1860 that slow procession of the ice will bring its dead once more to light,' those three bodies, looking so natural that they almost seemed asleep, were delivered for burial to their great grandchildren in the valley below."[1]

It is not reasonable to believe that these blood-curdling tales and tragedies of Alpine peaks constitute the real fascination of the Matterhorn and other lofty summits. In this country are snow and ice in plenty, and glaciers also, but they do not lure travelers to destruction. The same sun lights them here as there into radiance and beauty, and fancy can as easily conceive their myriad fantastic shapes to be the fountains and palaces of some celestial city. Every gulch above timber line has its snow banks, which grow deeper and deeper as one ascends. Any day or night a storm may drop a mantle of white upon the summits, but in the glare and heat of the summer sun it usually melts and vanishes. There are few peaks which can not be reached by the pedestrian with safety and comparative ease. There is no other experience known to man which produces the exhilaration and mental exaltation that comes with views from lofty summits. Distant empires seem to lie within the vision. Lifted miles above sea level in an atmosphere so thin and clear that the stars shine through and send their greeting, a conception of the awful sublimity and infinite magnitude of God's universe will penetrate then and there to the soul as perhaps it never did before. It is such sensations and emotions that repay the fatigue, the suffering from cold and loss of sleep, the hazards of dizzy cliffs and ice and snow, and the excessive cost in all ways which play so important a part in most Alpine ascents.

The avalanche which sweeps down the mountain side, mowing everything in its path and engulfing all at the bottom under hundreds or thousands of tons of snow, ice, rocks, and timbers, is always one of the sad features of a precipitous region where much snow falls. In the United States that is a danger of little moment during the summer and early autumn. The avalanche's harvest of destruction is gathered during the winter when the storms are raging or in the spring when the melting snows let go their hold. These tragedies of the mountains could hardly be invoked here during the tourist season by any recklessness, however wanton.

Cascades and waterfalls, fed by melting snows, are abundant in all mountain regions, and are a never-failing attraction. These can not be seen to advantage from moving trains, but always lend a charm to a trip on foot or by horse. Some are of extraordinary proportions. The Lower Falls of the Yellowstone descend 310 feet in one vertical

[1] This story appears in so many Alpine narratives that it is probably well founded.

LAKE TAHOE, CALIFORNIA.

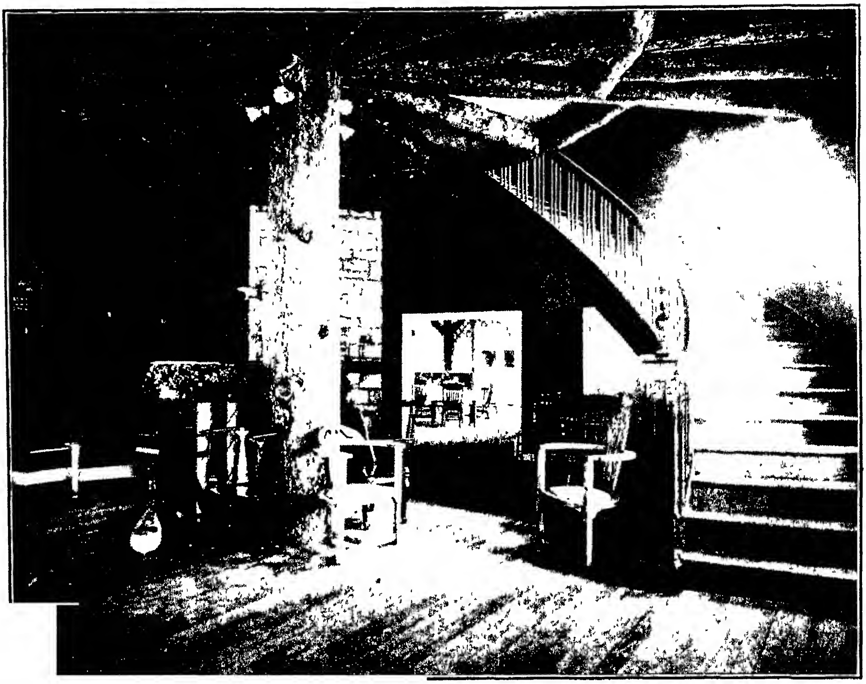

FIG. 1.—INTERIOR OF A POPULAR RUSTIC MOUNTAIN INN.

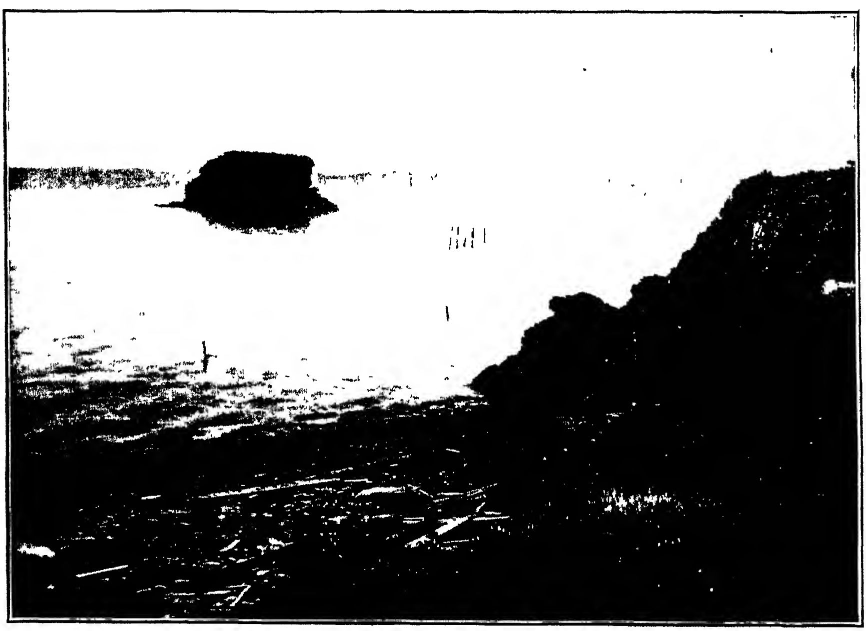

FIG. 2.—THE GREAT SALT LAKE, SHOWING PRINCIPAL ISLAND IN THE DISTANCE.

plunge; the Bridal Veil Falls in the Yosemite are more than twice as high and over 50 feet in width, while the Yosemite Falls, the highest waterfall in the known world with anywhere near the same volume, leaps 2,600 feet in three plunges, clearing over 1,500 feet at the first jump, 625 at the second, and the remainder in the last. The great Falls of Niagara (that apt Indian name meaning "thunder of waters"), although more than three-quarters of a mile wide, are less than 170 feet high in their farthest descent.

It is said that there is not a mineral spring in Switzerland which was not famous at least as far back as the Middle Ages, but in this vast western mountain region, like the waterfalls of Norway, they are so many and so varied that not one-fourth of them have ever been named.

A mountain lake is always a scenic gem. They are the mirrors in which man sees reflected the countless moods and fancies of the Deity. Like the cataracts, they are born of the melting snows. Their name is legion. To attempt to specify even the principal ones would be like trying to list the cities of the world. To mention a half dozen of those best known to the tourist, one would perhaps select Lake McDonald (Pl. LXXIII), in Montana, near which are to be found the most typical glaciers in the United States; Lake Chelan, in Washington, with its 60 miles of changing landscape on either shore; Lake Yellowstone, where the waters that come down from the mountains mix with those ever rising from plutonic depths; Lake Cœur d'Alene, in Idaho, a lake of entrancing beauty, but with a name suggestive of troubled scenes and wicked deeds; Lake Tahoe (Pl. LXXIV), in California, of which Mark Twain said, upon seeing it for the first time nearly forty years ago, "I thought it must surely be the fairest picture the whole earth affords;" and Lake San Cristobal, in Colorado, a lake in an oval cup, which, when the sunset gilds its mountain walls, looks like a huge sapphire in a setting of purple and gold.

But the Great Salt Lake! that imprisoned fragment of a prehistoric ocean! It is one of the wonders of the world. It still covers 2,500 square miles of its old bed, although its contour has been shrinking for ages. (Pl. LXXV, fig. 2). The lines of former ripple marks may be seen like steps carved upon the distant mountains. Unlike the Dead Sea, in Palestine, 1,300 feet below sea level, its surface is level with the tops of the Allegheny Mountains. Its waters are more than four times as salt as those of the ocean; no living thing can exist within them. Owing to their extraordinary buoyancy, a man can stand up and walk in them. Fed by four fresh-water rivers, the lake has no outlet, but wastes in vapor to the clouds. Its principal tributary is the River Jordan, which comes down from the Wasatch Mountains, widens out into beautiful Utah Lake, and again contracts to pour its waters into this strange salt sea, just as its namesake in Palestine comes down out of the mountains of Lebanon, widens out into the Sea of Galilee, and again contracts to feed the Dead Sea. It has islands

of very considerable height and size, with trees and meadows and running streams, and perfect, gently sloping beaches of white sand.

Only the briefest reference can be made to other attractions in this wonderful mountain-field. The crumbling ruins of the homes of the ancient cliff dwellers cover thousands of square miles, and are a subject of absorbing interest to the tourist and the student. There are the stupendous canyons, which the Almighty, to whom a thousand years is as a day, has been hewing out with infinite patience; the geysers, which send their vast volumes of water, mud, and steam high into the air, impelled by some force in the subterranean depths about which man may speculate, but whose mystery he will never fully solve; the giant trees, whose beginning was coeval with that of Christianity; the great wind cave in South Dakota, which rivals the Mammoth Cave of Kentucky; the thousands of forms in which the flora and fauna of this region are not duplicated elsewhere; the enormous deposits of ore that have been the foundation upon which has rested so much of this country's wealth. There are countless ways to study and enjoy and receive profit in this most prolific region.

PRESENT MEANS OF REACHING SCENIC REGIONS OF THE UNITED STATES.

How easy or how difficult is it to reach the various parts of the scenic regions is the next question to be considered. Few realize the progress which has been made west of the Missouri River. (Pl. LXXVI, fig. 1.)

In July, 1865, the first rail was laid west from the city of Omaha. At that time the nearest railroad on the east was far away, and the only means of communication was by boat on the river. The first year but 40 miles of track were laid. There was not a settlement on the proposed line from the Missouri River to the Sierra Nevada Mountains. The work was all done under guard of the United States Army, and graders and trackmen were often called upon to fall into line and protect themselves, or go to the rescue of some neighboring railroad camp attacked by savages.

Less than four years later, on the 10th of May, 1869, the last spike was driven at Promontory Point, in Utah, and the first transcontinental railroad linked with bands of steel our Eastern to our Western coast.

In March, 1871, ground was broken for the first scenic transmountain railroad of the West, running from Denver over the divide between the Platte and the Arkansas. Ten months later it was opened for traffic to Colorado Springs, a distance of 76 miles. The following year it was opened to Pueblo, 120 miles from Denver, with a stub of about 45 miles to the coal fields of the Arkansas. The little iron rails, weighing but 30 pounds to the yard, were brought from Europe. Previous to the opening of passenger service the triweekly stage, which ran between Denver and Colorado Springs, carried an average of five passengers a trip. But little was then known regarding the principles and practice of narrow-gauge railroading in the

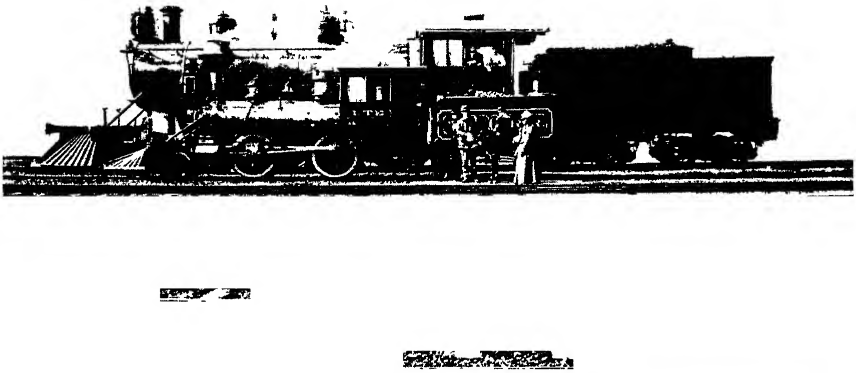

FIG. 1.—LOCOMOTIVES ILLUSTRATING ONE GENERATION'S PROGRESS.

FIG. 2.—RESCUING THE MONOLITH, YELLOWSTONE NATIONAL PARK.

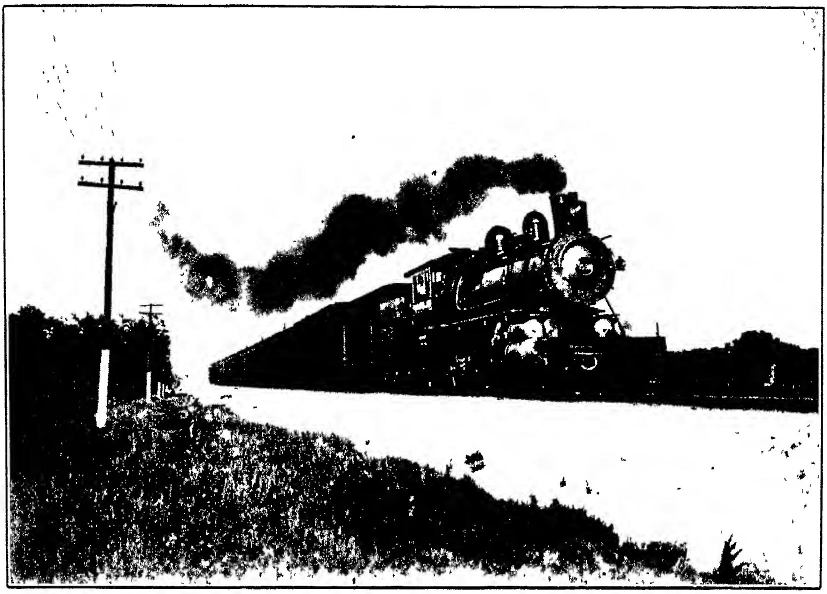

FIG. 1.—A TRANSCONTINENTAL LIMITED TRAIN TAKING ITS OWN PHOTOGRAPH AT 60 MILES AN HOUR.

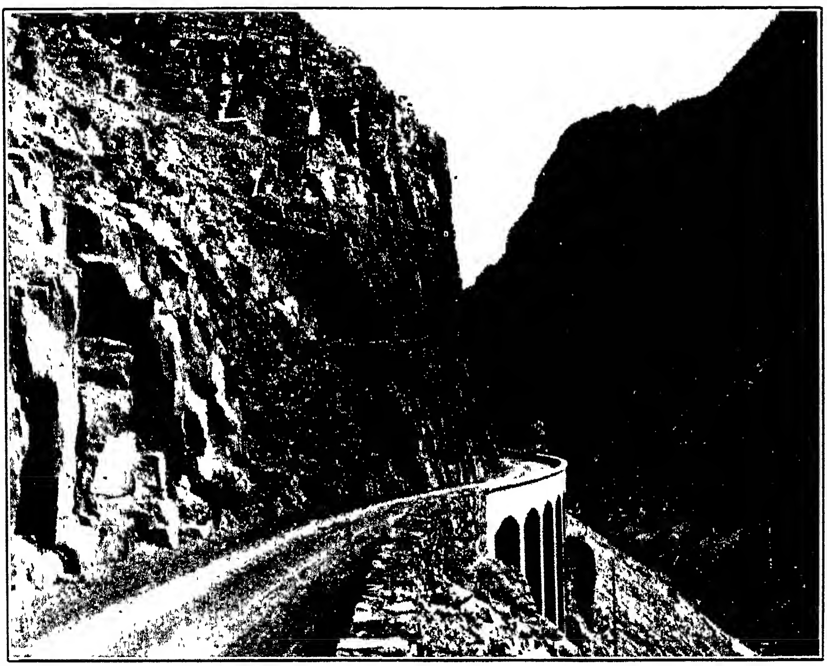

FIG. 2.—THE NEW VIADUCT AT GOLDEN GATE, YELLOWSTONE NATIONAL PARK.

mountains. The single train each way daily, with a speed averaging less than 15 miles an hour, was composed of one small engine, a composite baggage and smoking car, and one short passenger coach, with a row of very narrow double seats on one side and equally narrow single ones on the other.[1]

Now, six lines run through to the coast; extra branches and divisions occupy every important pass, gulch, and canyon, and six additional lines bring passengers and freight from the East to Denver.

The railroad conquest of this region is accomplished, and when the industrial history of the United States shall be written the names of Oakes Ames, Leland Stanford, William J. Palmer, Henry Villard, and James J. Hill will be among the ones which head the list of men deserving the country's highest gratitude and honor.

Thirty years ago one train a day, with a single sleeper, carried every passenger who traveled by rail to the Pacific. Now more trains, fully outfitted and equipped with every known comfort and luxury of railway travel, leave Chicago daily for the Pacific than leave any Eastern city in every direction.[2] In fact, the provision for the comfort of the ordinary passenger (who does not patronize the standard hotel car) from the Missouri River to the Pacific is very far in advance of what it is on any Eastern railroad. (Pl. LXXVII, fig. 1.) Every day in the year round-trip tickets are on regular sale between Chicago and the Pacific coast at a less rate per mile than they can be purchased between New York and Boston, while at special times excursion tickets reduce these rates by a very large percentage.

WHAT CAN BE DONE TO MAKE SCENIC REGIONS OF UNITED STATES MOST AVAILABLE.

The last question with which this paper deals is, What can be done to make the scenic regions most available, and what sort of expenditure in this line is most promising of results?

The answer clearly is, Get ready to entertain the people who are coming, for if we do they will surely visit us. The railroads are fully prepared to bring them to the doors of the regions, and it must be

[1] At the time so little attention was paid in this remote section of the country to commercial photography that no view of the train was ever made, so far as the most diligent investigation has disclosed. One of the little toy engines did elude the scrap heap. A view has been secured of it, using for a background one of the type of engines used through the mountains on the same road to-day.

[2] There is an interesting story connected with the effort by which the view of a standard transcontinental train was secured. The enthusiastic, resourceful young amateur who undertook it found that no apparatus hitherto used would give him satisfactory results on a train of that size running at the terrific speed of 60 miles an hour. Trial after trial resulted in failure. He finally, after a great many experiments, devised a new form of shutter that would give an exposure of one-thousandth of a second, which would allow the train to move about an inch while the shutter was open. This was operated by an electric mechanism, so arranged that the engine would close the circuit when it reached the point adapted to the position of the camera. The train then actually took its own photograph when running 60 miles an hour.

made easy and pleasant for visitors to reach those scenic attractions. They should have more good roads to drive over; good trails to ride and walk over. These should lead to every mountain peak and to or past each point of scenic interest. As the landscape gardener uses every art to bring out and embellish the beauties and attractions of his grounds, so the roads and trails should be studied to make them not only good in themselves, but also to provide them with features which shall compel attention and cause visitors to remember and talk about them.

It is generally true of an important scenic road that some particular feature impresses itself with especial vividness upon the attention and recollection of all who have occasion to travel over it. This may be an unusual landmark, a spot with a legend or a history, an unexpected view, a natural object of suggestively realistic form, or some artistic handiwork of man. This landmark becomes so well known through the ready narratives of drivers and guides, local publications, scenic bulletins, newspaper articles, etc., that every traveler looks for it, and long after he has gone remembers and talks about it; and thus the road where it occurs gets to be better known because of it.

Near the lower entrance to the Golden Gate, on that superb road system of Yellowstone National Park, stands a vertical prong of rock, a sort of rough monolith, with slightly elliptical cross section, perhaps 7 or 8 feet thick, in larger diameter at the base and tapering gently to a height of 12 or 15 feet. (Pl. LXXVI, fig. 2.) This came to be a familiar landmark, and when a year or two ago Captain Chittenden planned to reconstruct this portion of the road, preparatory to building a beautiful concrete viaduct (Pl. LXXVII, fig. 2) and revising the grade, the higher location at this point threatened a sacrifice of the old stone. But so many and earnest were the protests that he decided to preserve it. Having first erected for it a substantial base built up to the level of the upper grade, he carefully elevated the huge rock to its new position. Thus rescued and preserved, its former interest has been augmented a hundredfold. Every traveler who passes it hears the story and goes home to tell it, and with it he tells much about the roads of the park that perhaps otherwise might never have found lodgment in the memory.

But these accidents of nature never impress so permanently as does some work of great artistic merit. Along this line may be given what Stoddard says of the St. Gothard: "It is in truth the king of Alpine roads, resembling a mighty chain which man, the victor, has imposed upon the vanquished Alps—one end sunk deep in the Italian lakes, the other guarded by the lion of Lucerne." The allusion is to that masterpiece of Thorwaldsen, a gigantic lion 30 feet in length.[1]

[1] Stricken with a mortal wound the lion lies in death's last agonies stretched upon the floor of a cave. His closing eyes are taking a farewell look at the escutcheon of the Bourbons, whose sculptured lilies are covered by his fast-relaxing paw. Above him are carved the words "Helvetiorum fidei ac virtuti" ("To the fidelity and virtue of the Helvetians," as the Swiss were then called, the word virtue being used in its original sense of manly courage and valor).

FIG. 1.—THORWALDSEN'S LION, ST. GOTHARD ROAD, SWITZERLAND.

FIG. 2.—OURAY, THE GREAT UTE CHIEF.

(Pl. LXXVIII, fig. 1.) This is one of the most impressive monuments in Europe, and was cut by the artist in the solid wall of the cliff to commemorate the heroic defense of the Tuileries by the Swiss guards, August 10, 1792. The French Revolution had begun; their sovereign, Louis XVI, had fled, and they sacrificed their lives in vain; but their valiant deed, thus immortalized, will outlive the centuries. The short quotation from Stoddard shows how a suitable masterpiece of art, immortalizing a noble action, distinguishes the road near which it may be. The conviction that we should not ignore the suggestion and inspiration thus afforded impels the writer to submit an imaginary example to illustrate and emphasize the principle.

In the early seventies, immediately after the Uncompahgre Utes had ceded to the United States what is known as "The San Juan region," Otto Mears, with an optimistic confidence, which seems little short of inspiration, began to build that wonderful system of mountain roads that gave him the title by which he will always be known in Colorado history, "The Pathfinder of San Juan."

The Uncompahgres still retained the larger part of their old reservation. This must be crossed before the Mears road could enter the main range, where prospectors had just begun to make important discoveries. The only output had been thrilling tales of hardship and adventure, with a few alluring statements of rich finds and an occasional specimen of silver-bearing rock that found its way to Denver. That city by the nearest existing route was then over 400 miles away, and that nearly half the distance by the crudest of Indian trails. But he built the road from Saguache across the reservation, past the door of the rude adobe home of Chief Ouray[1] (Pl. LXXVIII, fig. 2), through the canyons and over the highest passes, and opened to the world a section of great and enduring value. For many years this road system was the sole avenue of communication with the outside world, and this was sometimes blocked for months by impassable drifts of snow.

On that old Mears road, in the wildest part of the Uncompahgre Canyon, so high above the boiling torrent that it looked like a small green and silver ribbon shimmering in the awful depths below, men, let down by ropes, carved in the almost vertical wall of the frowning

[1] That friction which always emits heat upon an Indian frontier was not wanting there. Many impetuous individuals of each race, impatient of restraint, encroached upon the privileges of the other. The relations at times became so critical that it seemed as if actual hostilities must soon begin. But Chief Ouray never lost head or temper. He was the stanchest, truest friend whom the white man ever had among his red brothers in the West. And he was, withal, a great man; a statesman by instinct, keen of reason, with broad charity, unfailing patience, and wonderful control over himself and his tribe. No provocation was ever so exasperating, or danger of outbreak so imminent, that his wise counsel and skillful diplomacy did not find some peaceful way out. The Utes (called interchangeably Uncompahgres and Utes) long since parted with the remainder of their reservation and moved to a new home beyond the limits of the State. Ouray went with them, but his mission seemed to end when he was compelled to leave the home and the graves of his fathers, and he soon sickened and died.

precipice a shelf, and from it made the road. It raises no invidious comparison to say that it is the most remarkable piece of mountain road ever constructed in the United States. Hundreds of people every year take that long trip (they can go on the railroad now) just to ride over the Mears road. The writer has yet to learn of the first one who did not hold his breath and exclaim: "I did not know that there was anything in America like it. This is indeed sublime."

Would it not be a fitting memorial for such a place if some American Thorwaldsen, beside this road in the canyon that bears the name of the tribe over which Ouray ruled, should chisel upon that wall of everlasting rock the form and features of the illustrious chief, and inscribe above it the legend, "To the fidelity and virtue of Ouray"?

There must be suitable hotels, inns, boarding houses, bath houses, tennis courts, golf links, polo grounds, and boats for the lakes; the streams must be kept supplied with fish; courteous and efficient guides must be at hand when desired. Many places are already provided in these respects, while others are woefully lacking.

The methods and practices of other regions and countries where the tourist is made a source of revenue should be carefully studied. Hotels and inns need not all be either elaborate or expensive. It is not the large caravansary which excites the thrill of anticipation in the breast of a tired and hungry traveler; it is the pretty, artistic, tasteful, rustic place of shelter which suggests a cozy room, appetizing home cooking, and restful comfort. (Pl. LXXV, fig. 1.) Pomp and flourish, waiters in garb and demeanor better fitting a funeral than a feast, are more suggestive of a big bill than value received. A successful host or hostess is, like a poet, "born, not made."

In a plain, rustic hotel in eastern Oregon presides a dear old lady. Sun rays always seem to be in her beautiful white hair; her welcome is like the greeting of the dawn; her good-by is a benediction. An embodied spirit of benevolence and good cheer, she captures the heart of every guest who crosses her threshold. The food upon her table reminds one of childhood's days and its choicest memories. Such are the tourist's friends, and they draw him like a magnet.

CONCLUSION.

A study of the conditions which make for success in scenic regions promises great pecuniary returns. The records of the railway passenger departments show that the Western tourist business is largely increasing year by year. When the skies in other States become like furnace walls of molten brass, the cool, revivifying atmosphere of these mountains makes them seem a haven of refuge, and the more inviting they are made the more income will be derived from this feature of Nature's bounty.

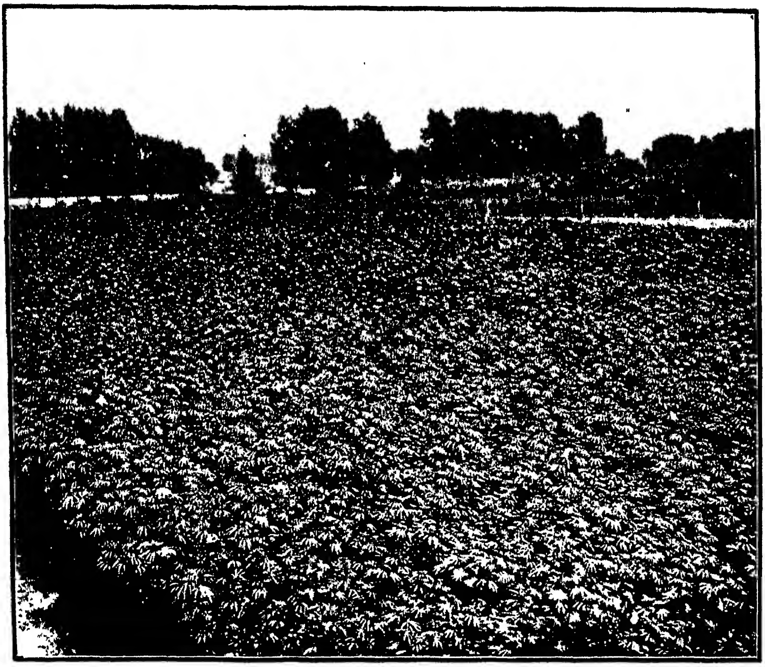

FIG. 1.—YOUNG HEMP, ABOUT 4 FEET HIGH, GROWING FOR FIBER.

FIG. 2.—HEMP PLANT OF CHINA-KENTUCKY TYPE, GROWN FOR SEED.

[Plant with leaves, pistillate; leafless plant, staminate.]

FIG. 3.—HEMP PLANT OF SMYRNA TYPE, GROWN FOR SEED (PISTILLATE).

THE HEMP INDUSTRY IN THE UNITED STATES.

By Lyster H. Dewey,
Assistant Botanist, Bureau of Plant Industry.

THE HEMP PLANT.

The hemp plant (*Cannabis sativa*) is an annual, belonging to the nettle family. It grows to a height of from 5 to 15 feet, and when cultivated for fiber (Pl. LXXIX, fig. 1) produces only a few small branches near the top of the slender stalk. Its leaves, of a rich dark-green color, are composed of 5 to 9 lanceolate, serrate, pointed leaflets, 2 to 5 inches in length and about one-sixth as wide. The staminate, or pollen-bearing flowers, and the pistillate, or seed-producing flowers, are on separate plants (Pl. LXXIX, fig. 2), both plants being nearly alike, but the staminate plants maturing earlier. The stems are hollow, and in the best varieties rather prominently fluted. The fiber consists of numerous series of long cells in the inner bark, firmly knitted together, which, when cleaned from the surrounding tissues, form tough strands nearly as long as the entire plant. This is a bast fiber, and is classed commercially among the soft fibers, with flax, ramie, and jute.

The hemp plant originated in central Asia, but it is now widely distributed, especially in the North Temperate Zone, growing spontaneously where it has been accidentally introduced with bird seed or cultivated for the fiber.

OTHER PLANTS CALLED HEMP.

The name "hemp" was first applied to the plant above described, but in recent years it has unfortunately been used to designate the sisal plant, or henequen, a species of agave producing a leaf fiber, and the manila fiber plant, or abacá, a kind of banana plant producing structural fibers in the leaf petioles. Sansevieria, a tropical genus belonging to the lily family, includes three or four fiber-producing species, often called bowstring hemp, and an East Indian species, *Crotalaria juncea*, is commonly known as Sunn hemp. The name is also applied to several other species of less importance.

PRINCIPAL USES OF HEMP FIBER.

Hemp fiber is long, soft, very strong, and capable of almost as fine subdivision as flax. It is especially adapted for use where strength is required. It is used in the manufacture of fine twines, carpet thread, carpet yarns, sailcloth, and for homespun and similar grades of woven

goods. Nearly all of the best grade of long fiber, "dressed line," is used for making twines, yacht cordage, etc.; cheaper grades are made into binder twine. The tow is used for threads and for yarns to be woven into carpets, homespuns, and linen goods, and the refuse fiber combed from the tow is used as oakum for calking ships. The average annual consumption of hemp fiber in the United States is about 18,000,000 pounds, of which only about 8,500,000 pounds are raised in this country, the remainder being imported.

REGIONS OF CULTIVATION.

FOREIGN HEMP.—In foreign countries hemp is cultivated most extensively in Russia, China, Japan, Italy, Austria, and France. The tallest and best hemp plants are produced in China and Japan, but the best grades of fiber are imported from Italy, where it is prepared by water-retting. It is not cultivated commercially for the production of fiber in the Tropics.

DOMESTIC HEMP.—In the United States the production of hemp is almost confined to Kentucky (fig. 43). Three-fourths of the American hemp fiber is produced in that State in the counties of Fayette, Woodford, Jessamine, Garrard, Clark, Bourbon, Boyle, Scott, and Shelby. These nine counties are in the famous blue-grass region, of which Lexington, the principal hemp market, is the center. The most important secondary hemp markets in this region are Nicholasville, Versailles, Lancaster, Danville, Winchester, Paris, Georgetown, Shelbyville, and Frankfort. Small scattered areas of hemp are cultivated intermittently in other parts of the State, and there are probably few counties in Kentucky in which an attempt has not been made at some time to establish the hemp-growing industry.

There are two centers of hemp cultivation in Nebraska—Fremont and Havelock. During the past two or three seasons about 100 acres have been grown at each of these places. In California, hemp is cultivated at Gridley, in Butte County. The industry has been gradually established there during the last half dozen years, and having passed the stages of experiment and loss due to new and untried conditions, there is now a tendency to develop and increase the acreage. Trials in hemp cultivation have been made on Ryers Island, near Riovista, in the Sacramento Valley, and in San Benito County. During the past two years hemp has been grown successfully on a small scale near Houston, Tex., and with improved methods of handling the crop it seems probable that it may become a profitable industry in that region. Hemp has been grown in the vicinity of Champaign and Rantoul, in eastern Illinois, and along the Missouri River, between St. Joseph and Kansas City, but its cultivation in these localities has been almost discontinued, except at Rantoul, where about 400 acres are still cultivated each year.

SOILS SUITABLE FOR HEMP.

In Kentucky, as stated, hemp is cultivated most successfully in the blue-grass region, where the soil is chiefly a yellow clay loam or a rich sandy loam, rather firm in texture and usually underlaid with a subsoil of yellow clay. The land is gently rolling, affording excellent drainage. Exceptionally fine crops are produced on the bottom lands along the Kentucky River and its tributaries, although it is regarded as risky to cultivate it where it is subject to overflow. A good stand of well-developed hemp plants is rarely obtained in undrained hollows in the uplands, although the soil in these hollows seems more fertile than that on the surrounding hillsides.

In Nebraska hemp is cultivated on rich, black, friable prairie loam, comparatively loose and light in texture and lying high, with good

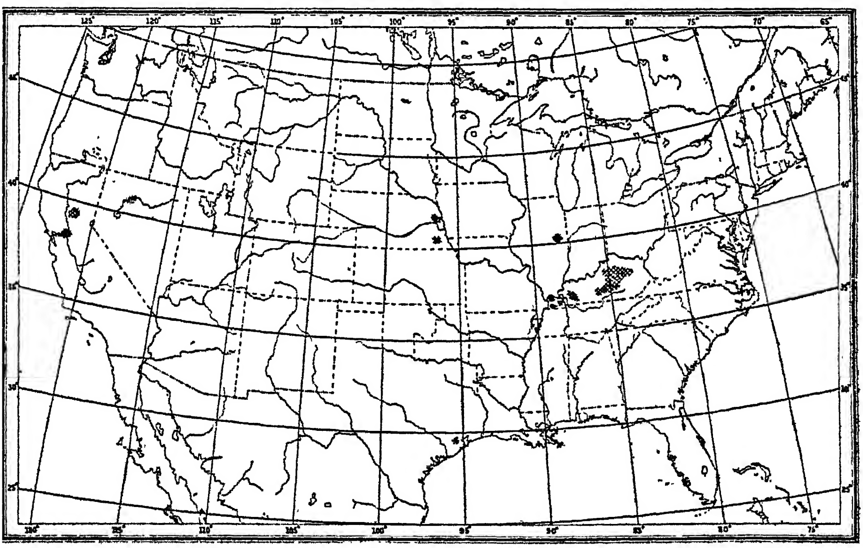

FIG. 43.—Hemp production in the United States: Areas of cultivation indicated by shaded lines.

drainage. Repeated efforts to cultivate hemp on the "gumbo" and other low-lying soils there have demonstrated that while these soils may produce some large hemp plants it is practically impossible to secure on them a good, even stand of hemp stalks of the proper size for fiber. In Texas good crops of hemp have been produced on rich dark prairie soil, but on upland soils, subject to drought, the crop has proved a failure. In California hemp is grown on alluvial soils in the bottom lands along the rivers. In the testing gardens of the Department of Agriculture, where several European and Japanese varieties of hemp have been tested during the past two years, the plants have attained a good height, but they have been uneven in size, and the fiber produced is not as tough as that produced in Kentucky

and Nebraska. The soil of the testing garden is alluvial, composed chiefly of sand and silt, and almost devoid of clay.

An ideal hemp soil must be rich in available fertilizing elements, especially nitrogen and potash, to insure a rapid growth; deep and sufficiently loose in texture to permit the development of the root system and also to allow good drainage; sufficiently friable to make a good, mellow seed bed, so as to insure uniform germination of seed, yet with clay enough to give it a good body and firm texture. A good supply of humus (decaying vegetable and animal matter) is necessary, not only to furnish plant food, but to retain moisture. Very few farm crops require so much water as hemp, yet it will not endure standing water about its roots. It is not grown commercially under irrigation, and the effects of inundation on crops in river bottoms indicate that it would not thrive if subjected to the ordinary methods of flooding practiced in the irrigation of broadcast crops. In soils of good capillarity, where the general level of the soil water is within 10 feet of the surface, there is little danger of injury from drought after the first thirty days, during which the root system of the hemp plant will become well established.

PREPARATION OF LAND.

Rotation of crops.—In Kentucky, hemp sometimes follows hemp on the same land for two or three years, and if the stalks are retted on the same land and fertilizer applied to make up for the fertility taken off by the crops, no serious injury may result. It is the general practice, however, and doubtless the better practice, to cultivate a series of crops in rotation. A common five-year rotation is clover, hemp, corn, wheat, clover. Clover seeded in the growing wheat in spring occupies the land two years. Hemp follows clover whenever this is practicable. The stubble and roots of the clover, rich in stored-up nitrogen, furnish the desired fertilizing elements well distributed, and also the humus necessary for the development of a rapid-growing crop like hemp in soils long under cultivation.

In California and Nebraska no crop rotation is practiced for hemp, and on the deep, rich prairie soils of Nebraska, where there seems to be an almost inexhaustible supply of humus, it is claimed that the best results are obtained where hemp follows hemp through a long series of years. Hemp prevents the growth of weeds and other vegetation which would be found on such soils in most other crops or after other crops are laid by, and its cultivation also seems to make the soil more uniform in character.

Fertilizers.—In California and Nebraska the hemp is retted on the land where it is grown, and in this manner a portion of the fertilizing elements in the crop is returned to the soil. No other fertilizer is used in those States, and none seems necessary as yet on the deep,

rich soils. In Kentucky, hemp is cultivated in a region noted for its horses and fine herds of cattle and sheep, as well as for its blue grass and hemp. The soils throughout this region have been kept in a high state of fertility, as is nearly always the case where stock raising is an important element in mixed farming. Barnyard manure is applied to corn and wheat, the crops preceding hemp in the rotation, but no fertilizer is applied to the hemp crop itself. Fresh stable manure applied as a top dressing produces an uneven growth of hemp plants, and when plowed under just before seeding it has a tendency to dry out the soil. Fertilizers, to produce satisfactory results with hemp, must be thoroughly and uniformly mixed with the soil, and should have a tendency to retain moisture. Barnyard manure and clover sod, therefore, being humus formers, may be expected to give better results in the long run than commercial fertilizers, which tend to deplete the humus. In the Southern States, where clover does not succeed and where stock raising has not yet received due attention, cowpeas and cotton-seed meal will make good fertilizers for hemp. Alkaline chlorides like chloride of sodium (common salt) tend to increase the cellulose in plants at the expense of starch and sugar.[1] The application of salt may therefore be expected to increase the quantity and also to improve the quality of fiber in the hemp plant, and in experimental cultures this has been proved to be true. Salt must be used with caution, however, since it is likely to prove very injurious on light soils or soils lacking in fertility. Muriate of potash has an effect similar to that of common salt.

PLOWING AND HARROWING.—The best results are usually secured from deep fall plowing, followed by thorough harrowing in the spring. In practice, however, the land is plowed at all seasons through the fall, winter, and early spring, when the weather and conditions of the soil will permit. The hemp spread for retting often remains on the ground nearly all winter, and this prevents fall plowing when hemp is retted on land to be used for the same crop. In Kentucky the hemp is usually spread for retting on permanent pasture land, so as not to interfere with plowing. Thorough, deep plowing is necessary to fit the soil to retain moisture and to give opportunity for the development of the roots. Harrowing before the seed is sown is generally necessary to make the surface seed bed fine and uniform. Harrowing is advisable even in loose, friable soils which are pretty well pulverized by the plow, since the rough furrows left by the plow will result in uneven covering of the seed and lack of uniformity in germination.

SEEDING.—For the best results the seeds should be sown in spring at about the time for sowing oats. In Kentucky, hemp seed is sown from the middle of March to the last of April; in Nebraska, from

[1] Storer's Agriculture, Vol. II, p. 742 (1897).

April to June; in California, in February and March. The best hemp crops are obtained by drilling and cross drilling with a force feed drill. This distributes the seed evenly and covers it at a uniform depth. An even stand of plants, uniform in size, is one of the principal objects to keep in mind in nearly every operation in hemp culture. It is well-nigh impossible to make good fiber from a mixture of stalks of various sizes. Unevenness in size of stalks will result from a lack of homogeneity of soil or from a lack of uniformity in the surface, in the distribution of the seed, or in the depth at which the seed is covered. A bushel of seed per acre is the quantity usually sown. If the seed is fresh (from crop of previous year), is small-sized, and germinates well, this quantity is ordinarily sufficient; but on very rich soils a heavier seeding and on poor soils a lighter seeding is advisable. Good hemp seed should germinate 85 to 95 per cent within ten days. Before sowing it is advisable to make a test to determine the percentage of germination, and to use the data thus obtained in determining what amount of seed per acre to sow.

WEEDS.—If the land has been properly prepared before seeding and the soil is suitable for hemp, weeds will rarely grow sufficiently to injure the crop. In some instances it may be advisable to pull out pokeweed, smartweed, and tall ragweed, when these overtop the hemp before it is 2 feet high, but it is best not to tramp through the crop more than is necessary, for bending and breaking the young plants will cause uneven growth. Broom rape (*Orobanche ramosa*), an annual plant parasitic on hemp roots, is the most injurious weed in hemp fields.[1] It is disseminated by its very abundant small seeds, similar in size to those of tobacco, which adhere to the resinous coverings of hemp seed. It is most injurious in Kentucky and Illinois, sometimes causing almost complete ruin in hemp crops. No complaints of it have been received from California, and although it has been introduced in Nebraska, it has not caused any damage to the hemp crops there. Broom rape is an inconspicuous plant, growing not more than 6 to 12 inches high at the base of the hemp stalks, and is usually not noticed until the hemp plants suddenly begin to turn yellow and die a few weeks before harvest time. In some instances a partial crop is saved by cutting the hemp as soon as the first effects of broom rape are observed, but the fiber thus obtained is usually rather weak. The seeds of this weed retain for a long time their ability to germinate, lying dormant in the soil, and control or eradication is thus rendered extremely difficult. It can develop only on the roots of a few crops like tobacco, hemp, and tomatoes, and the best remedy is to leave these crops out of the rotation on infested land for a period of at least twelve or fifteen years.

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[1] H. Garman, "The broom-rape of hemp and tobacco," Bul. 24, Kentucky experiment station.

Aside from broom rape, which, being parasitic, does not require light, there are few weeds which can persist in the dense shade produced by the hemp as grown for fiber. The hemp grows so rapidly and attains such a height that it overtops all ordinary weeds and chokes them out. It is generally regarded as an excellent crop for clearing land of annual or biennial weeds, and it has been suggested as a good crop for subduing the growth of wild vegetation on reclaimed river bottom lands. Unless such soils could be well prepared by thorough cultivation, it is not likely that a satisfactory yield of fiber could be secured.

HARVESTING.

TIME OF HARVESTING.—Hemp is cut when the staminate plants are in flower. The time of harvest varies from eighty to one hundred and forty days from the date of seeding, the period of growth depending on the mean temperature and the supply of moisture, and on the variety. When sown at the proper season hemp is usually cut late in August or September (in July in California and Texas).

In some instances good fiber has been secured in Nebraska from hemp cut before flowering, but ordinarily the fiber is best when the crop is harvested just before the staminate plants are in full flower. If cut too early the fiber will be fine, but lacking in strength, deficient in yield, and wasting at every operation in its preparation. If allowed to become too mature the fiber will be coarse, harsh, and brittle.

METHODS OF HARVESTING.—In California hemp is cut with self-rake reapers or mowing machines. In Nebraska mowing machines have been superseded by self-rake reapers (fig. 44). Reapers have been used quite extensively in Kentucky during the past two years, and they seem to be growing in popularity there. Most of the hemp in Kentucky, however, is still cut by hand with the primitive reaping knife or hemp cutter, which is something between a corn cutter and a bush scythe, but unlike either (Pl. LXXX, fig. 1). An experienced hand with a reaping knife will cut about one-half acre per day. With a sweep-rake reaper, under favorable conditions, from 5 to 7 acres may be cut in a day, and with a mowing machine, 7 to 10 acres. Hemp does not lodge like grain or heavy clover, but on windy days it is impossible to cut with either reaper or mower in the direction that the wind is blowing, for instead of falling back of the cutting bar the stalks drop down between the guards, where they are repeatedly cut off. The heavy, green, woody stalks, one-eighth to one-half inch in diameter and 8 to 14 feet tall, are much more difficult to handle than grass or grain, and they cause a much greater strain on the machine. Ordinary grain reapers are not entirely satisfactory for harvesting hemp; they are rarely strong enough. The experience of those who have used reapers indicates that a successful hemp-harvesting machine

of the self-rake type should be made especially strong, having a cutting bar not more than 3½ feet long, arranged to cut within 2 inches of the ground, extra heavy sections with rapid motion, and driving wheel with broader rim and larger lugs than are usually made for self-rake machines. Opinions differ as to whether two or three rakes give the best results. A team of four good farm horses is generally regarded as necessary for cutting hemp with a self-rake reaper, and

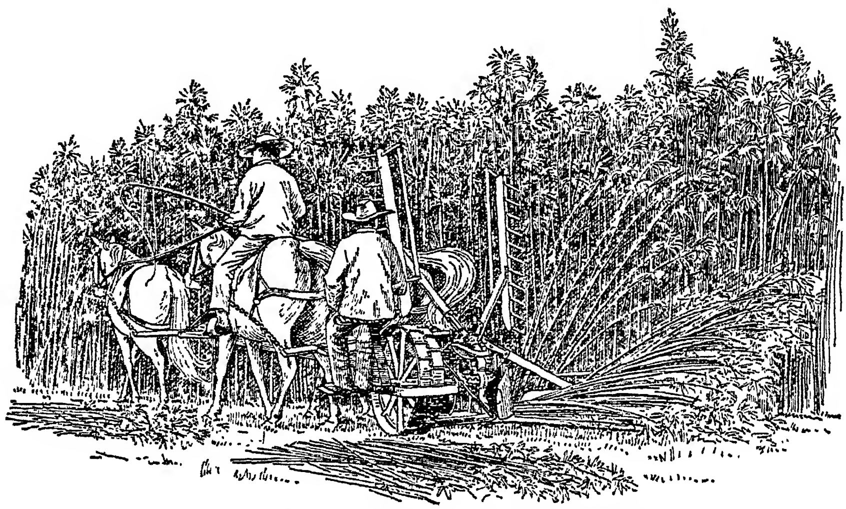

FIG. 44.—Cutting hemp with self-rake reaper in Kentucky.

in Kentucky an extra hand is employed to drive. In California and Nebraska one man attends to both horses and machine. Some form of harvesting machine must soon take the place of the hemp knife, since it is ever more difficult to secure the skilled labor necessary to cut the crop by hand, and where hemp is raised on a large scale it is impossible with the slow hand methods to get it all cut at the proper season.

DRYING AND STACKING.

After the hemp is cut it is allowed to lie on the ground from four to eight days to dry. The unbound bundles are usually turned, so as to dry both sides. To turn them a stick or fork handle is run under the tops and they are thrown endwise over the butts. When dry the hemp is usually bound in small bundles with cheap twine or the small hemp stalks and set up in shocks (Pl. LXXX, fig. 2) or stacked. If it is soon to be spread for retting on the same land it is placed in shocks without binding. When cut with a mowing machine the tangled stalks are raked into windrows like hay. In stacks properly built (Pl. LXXX, fig. 3) the hemp will remain uninjured for a period

of two or three years; furthermore, the quality of the fiber is improved, and the processes of breaking and cleaning it are made easier by a kind of sweating or fermentation that the stalks undergo in the stack. In spite of the advantages to be gained in stacking, it is often omitted on account of the extra handling and the lack of skilled labor to make the stacks, which must be constructed with even greater care than stacks of wheat or oats.

RETTING.

Retting, or "rotting," is a process in which the vegetable gums surrounding the fiber are dissolved and the fiber is at the same time freed somewhat from the woody interior portion of the stalk and also from the thin outer cuticle. These gums are not soluble in water, but they are destroyed by a kind of putrefaction which takes place when the stalks are immersed for some time in soft water or are exposed to the weather.

WATER RETTING.—Retting by immersing the stalks in water is largely practiced in France and Italy, and it was practiced in this country until the middle of the last century, before hemp was so completely superseded by cotton in the manufacture of fine woven goods. Water-retted fiber is lighter in color and finer in texture, and it commands a higher price than dew-retted fiber, but it requires a large amount of labor and expensive retting tanks. No process has yet been devised in America by which hemp can be water-retted so as to make it yield as great a profit as when dew-retted.

Investigations in Europe have demonstrated that certain micro-organisms are always present in flax when retting, and these agents play a most important part in the retting process.[1] It is suggested that pure cultures of these amylo-bacteria can be made to facilitate the retting in much the same manner that fermentation is started in making wine and vinegar. In experiments conducted on a small scale flax was retted much more rapidly when the bacteria were supplied. The process of retting hemp is exactly the same as that of retting flax, and it is possible that by making use of the necessary bacteria the length of time and labor required for water-retting may be reduced to within the limits of profitable production. It seems impracticable, however, on account of the great bulk of the crop, to attempt to carry on the operation of retting under cover, as would be necessary in order to have the conditions under control. It may be possible to use the bacteria in a solution to spray on the hemp as it is spread for retting in the field.

DEW-RETTING.—Nearly all the hemp now produced in the United States is dew-retted. It is spread in long rows on the ground during

[1] S. Winogradsky, Comptes Rendus, Vol. CXXI, p. 742 (1895).

the fall and early winter and exposed to the weather until the bark, including the fiber, readily slips from the inner woody portion (Pl. LXXXI, fig. 2). In Nebraska and California the hemp is spread in the stubble fields where it has been cut. In Kentucky it is usually spread in closely cropped blue-grass pasture land, and is sometimes hauled 2 or 3 miles from the hemp fields to the retting grounds. The plants are turned at least once to secure even retting, the tops being thrown over in the same manner as when turned in drying.

In Kentucky most of the hemp is spread for retting during the month of November, but owing to unfavorable weather and inability to secure retting lands or labor at the desired time, the retting period often extends from soon after the harvest until the following spring. The time required for dew-retting hemp depends upon the weather, and varies from two to ten weeks. Warm, rainy weather causes the hemp to ret rapidly, but it increases the danger of loss, since it is often difficult or even impossible to turn the hemp while the rains continue, and it is retted unevenly or much of it is overretted. The process which seems necessary to destroy the vegetable gums surrounding the fiber injures the fiber itself if permitted to continue too long. A period of warm rains setting in after the hemp has been spread several days and has reached an advanced stage of retting is almost sure to prove injurious to the fiber. The best fiber is obtained from hemp retted slowly during the fall, since it is then easier to secure uniformity and also to check the process before it becomes injurious. Light warm rains soon after the hemp is spread are beneficial to start the retting process. Water charged with the specific bacteria for retting and applied with spraying apparatus might perhaps be substituted for these uncertain showers. When the hemp has been retted sufficiently for the fiber to be readily separated, the stalks are raked together and set up in loose shocks to dry, or hauled to the place where they are to be broken.

BREAKING.

Breaking is the process by which the fiber is separated from the stalk and roughly cleaned. It prepares the fiber for market as rough hemp, and is usually the last operation performed on it by the farmer or hemp grower. The work of breaking begins as soon as the retted hemp is ready, and often continues until late in the spring. The greater part is broken during January and February.

Hand breaks.—Nearly all of the hemp is broken by hand breaks (Pl. LXXXI, fig. 1), such as have been in use many centuries. The crude heavy wooden breaks are all made by carpenters after one very simple pattern, and cost only $5 to $6 each. With one of these an experienced hand under most favorable circumstances can clean out about 250 pounds of fiber in a day. The average day's product of

FIG. 1.—CUTTING HEMP BY HAND.

FIG. 2.—HEMP SHOCKS

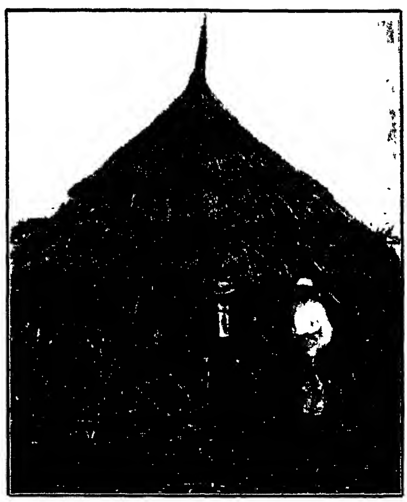

FIG. 3.—HEMP STACK.

FIG 1.—BREAKING HEMP ON HAND BREAK.

FIG. 2.—HEMP SPREAD FOR RETTING.

FIG. 3.—HEMP FIBER "DRESSED" (HACKELED) AND TIED IN BUNDLES FOR MARKET.

breaking is about 100 pounds of clean fiber. The usual wages paid for breaking is 1 cent per pound of fiber. The work is performed by alternately crushing or breaking the stalks between the long jaws of the break and beating and whipping them over the break to free the hurds from the fiber. It is a slow process, requiring not only strength, but skill. The value of the product depends largely upon the skill of the laborer. There is considerable loss of fiber in beating it against the break to shake off the hurds, and with new and unskilled laborers this loss is often an item of importance. The principal objections to hand breaking are its slowness and cost. To break an average crop of 50 acres requires the services of 10 skilled hemp breakers for two months and costs at least $500. The hand break must give way to machinery.

HEMP-BREAKING MACHINES.—Several machines have been devised for breaking hemp, but they have not given complete satisfaction. Very few of them have succeeded at all in breaking hemp in commercial quantities.

A machine consisting of a series of coarsely fluted rollers followed by a rapidly revolving spiked cylinder has been in use for some years in California and Nebraska. It breaks the hemp and delivers the fiber in the form of tow. This machine seems to be particularly well adapted to the preparation of fiber from tangled hemp stalks cut with a mowing machine.

In the hemp factories at Lexington there are machines consisting essentially of long series of corrugated rollers which are occasionally used for softening the fiber. It is said that these machines may be used for breaking hemp, but they are not actually so used. These and also the break used in California are too heavy to be taken into the field, and they require more power than can be furnished by an ordinary thrashing engine.

During the past season three decorticators have been in operation near Lexington, by which the hemp stalk is crushed in passing between rollers, corrugated for unretted hemp and smooth for retted. The hurds are then loosened by a rapidly vibrating mechanism, and the fiber is partly cleaned by a kind of carrier, which gives a rapid scraping motion. These machines break the hemp well and without waste or injury to the fiber, but do not clean out the hurds as well as is desired. They are portable, weighing only 2,000 pounds, and require only 6 horsepower for operation. An ordinary thrashing engine furnishes sufficient power to run two breaks. The hurds are used as fuel for the engine. The average day's output from each of these machines is 2,000 to 3,000 pounds of rough hemp. Attention is called to these machines especially, since they are the first portable machines that have proved successful, working out in the field and producing untangled long-line fiber similar to that cleaned on the hand break.

Breaking unretted hemp.—Several hundred tons of unretted hemp stalks have been broken on the decorticators used at Lexington during the past season. The fiber thus produced is degummed and prepared for spinning by a chemical process. The finished fiber produced in this manner is of fine quality, and is used for the same purposes as the better grades of imported flax. The process is not yet in general use, however, and there is only a limited market for unretted hemp fiber. It would effect a decided improvement in the industry if the farmer could break his hemp successfully and find a ready market for the fiber without the tedious and uncertain process of retting.

MARKET.

The rough hemp fiber is tied in bales weighing about 150 pounds each, and most of it is sold to dealers in the local markets. In some instances where it is cleaned better than usual it is shipped to the manufacturers, but most of it is hackled by the local dealers. This work is nearly all performed by hand, and consists in combing the fiber by drawing it across clusters of upright, sharp steel needles. The long fiber, nearly as long as the hemp stalks, combed out in this manner, is known in the market as "Kentucky single-dressed hemp." If the fiber is of especially good quality, it is combed still further upon a finer hackle, and it then becomes "Kentucky double-dressed hemp," which is the highest grade of American hemp quoted on the fiber market. (Pl. LXXXI, fig. 3.)

The price of hemp varies to a considerable degree, depending on the demand and supply of other fibers almost as much as on the production of the hemp itself. Most of the rough hemp is sold by the farmers during the winter soon after it is broken. The prices during the winter of 1901–1902 are regarded as comparatively high, being 4½ to 5 cents per pound. The approximate average prices paid to farmers by local dealers in Lexington, Ky., during the month of February for the past seven years have been as follows:

	Per ton (2,240 pounds).		Per ton (2,240 pounds).
1896	$60.00	1901	$112.00
1897	70.00	1902	105.00
1898	75.00		
1899	90.00	Average	87.42
1900	100.00		

The minimum limit of profitable production, according to present methods, is regarded as about 3½ cents per pound. With the present values and profits in other farm productions, a price considerably above this limit must be paid to induce farmers to grow hemp rather than devote their lands to stock raising and corn and tobacco. Even at the present time hemp is giving place to tobacco in Kentucky on many rich farms in the blue-grass region. The average production

for five-year periods for the past twenty-five years, based on reports of the commissioner of agriculture of Kentucky, is as follows:

	Pounds of rough hemp.
1876 to 1880	10,793,427
1881 to 1885	6,843,367
1886 to 1890	12,541,145
1891 to 1895	7,263,713
1896 to 1900	6,354,543
Approximate average for twenty-five years	8,700,000

The generally decreasing production is not due to a diminishing yield, but to a reduced acreage. A larger acreage was planted in 1901 than during the previous two years, and allowing for loss due to drought, the 1901 crop is estimated at about 8,000,000 pounds.

Under fair average conditions an acre of hemp yields about 1,000 pounds of rough fiber, or about 6,000 pounds of dry retted stalks. At 5 cents per pound for the fiber it is a very good paying crop. It is a reasonably safe crop, aside from the uncertainties of retting. It is not often seriously injured by fungous diseases or insects. Its most serious enemy is the parasitic weed branched broom rape, mentioned under "Weeds."

SEED AND VARIETIES.

Hemp seed is produced on plants grown in checks or sometimes in drills, and cultivated like corn. These plants grow stout and coarse, with numerous branches, and they are worthless for fiber. No horticultural varieties are recognized in this country. Nearly all of the hemp grown here in recent years is of Chinese origin. The seed is obtained in small quantities from American missionaries in central China, and this is usually cultivated for two generations for seed production before it is sown broadcast for fiber. This method is pursued not only to secure a sufficient quantity of seed, but also because better fiber plants are produced after the seed has been acclimated by cultivation in this country. The hemp growers of Kentucky generally agree in the opinion that the best hemp is produced by small dark-colored seed. In Japan, on the contrary, the best varieties have comparatively large light-colored seed.

The Chinese and Japanese varieties of hemp are very similar in character. They grow to a height of 9 to 15 feet, with slender stalks, few branches, and usually with internodes 8 to 12 inches in length. The pistillate flowers on the plants grown for seed are in rather small clusters, scattered on branches of the long slender limbs. (See Pl. LXXIX, fig. 2.) The European varieties, including the Piedmont, Neapolitan, Hungarian, and Russian, while sufficiently different in character to be readily distinguished, all conform to a general type,

sometimes called the Smyrna type.[1] (See Pl. LXXIX, fig. 3.) This differs from the China-Japan type in a more compact growth, shorter plants, shorter internodes, and shorter and more rigid limbs, bearing the seeds in rather large, dense clusters. These European varieties reach maturity from ten to thirty days earlier than the China-Japan varieties under similar conditions.

Until comparatively recent times hemp seed of European origin was used in Kentucky, and its effects are still plainly seen in the mixed character of plants too often found in the hemp fields. These plants are so prolific in seed that the growers hesitate to throw them out when harvesting their hemp seed.

An ideal hemp plant should be 10 to 12 feet in height, one-fourth to three-eighths inch in diameter near the base, with internodes 10 inches or more in length, and stems prominently fluted, with comparatively large hollows, making them thin-shelled and more easily broken. The fiber is generally tougher on the thin-shelled stalks. The Chinese and best Japanese varieties approach most nearly this ideal. Starting with these as a foundation and practicing a rigid seed selection for a half dozen generations or longer would undoubtedly result in improved varieties of uniform plants adapted to cultivation in this country.

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[1] S. S. Boyce, Hemp, 5 (1900).

THE CHINOOK WINDS.

By Alvin T. Burrows,
Observer, Weather Bureau.

ORIGIN OF THE APPLICATION OF THE NAME "CHINOOK" TO WINDS

At the present time there are three different winds called Chinooks. Each of them is essentially a warm wind, whose effect is most noticeable in winter. Under their influence snow is melted with astonishing rapidity and the weather soon becomes balmy and spring-like. The name "Chinook" is that of an Indian tribe which formerly lived near the mouth of the Columbia River. It was first applied to a warm southwest wind which blew from "over Chinook camp" to the trading post established by the Hudson Bay Fur Company at Astoria, Oregon. The name soon came into general use in that locality, and as the adjacent country was settled the usage extended, so that now "Chinook" is applied not only to the warm, moist southwest winds along the Oregon and Washington coast, but to the warm, dry, descending winds east of the Cascade range in Washington and the Rocky Mountains in Montana and elsewhere. In 1895 Mr. B. S. Pague, the local forecast official at Portland, Oregon, began to call the descending southeast winds that visited western Oregon and Washington during the winter Chinooks.

WET AND DRY CHINOOKS.

The warm, wet Chinook of the Pacific coast was for many years supposed to owe its existence to the Japan Current over which it was thought to blow. This is still the popular belief in many localities where the wind occurs. Scientific investigation has shown the fallacy of this view. The Japan Current is but a small fractional part of the Pacific Ocean and its influence is correspondingly small. Its effect, if any, on the wind would soon be lost, as this current does not approach within 1,000 miles of the Puget Sound country. The relative warmth of the ocean over which the winds must blow is itself a sufficient cause of any relatively high temperature accompanying the

wind. The moisture of these winds is obtained from the same inexhaustible source, the ocean.

The warmth of the dry Chinook in Montana and the one described by Mr. Pague occurring west of the Cascades is derived in a different manner. It results from a compression of air descending from a mountain, the moisture of which has been abstracted on the other slope. These winds are of the same nature as the foehn wind of Europe, and by some writers these two terms are used synonymously. The dry Chinook wind is defined by Professor Harrington, formerly chief of the Weather Bureau, as follows: "A warm, dry, westerly or northerly wind occurring on the eastern slopes of the mountains of the Northwest, beginning at any hour of the day and continuing from a few hours to several days." Others make the definition somewhat broader. According to them this wind is defined as a warm, dry wind from the southeast, south, or southwest when west of the Rocky Mountains, and from the southwest, west, or northwest when east of the Rocky Mountains, beginning at any hour of the day or night, and continuing from a few hours to several days.

DISTRIBUTION AND CHARACTERISTICS OF CHINOOK WINDS.

The distribution of the Chinook is rather wide. It occurs most frequently in Washington, Oregon, Montana, Idaho, Wyoming, and the Dakotas, in the United States, and in the region immediately north in the British Possessions. There are authentic instances recorded of this wind in Nebraska, Iowa, Minnesota, and even Wisconsin. These latter visitations are rare, and the fact of their being genuine Chinooks is questioned. Professor Abbe states that a wind similar to the Chinook makes its appearance east of the Appalachian range.[1] The winds that bring fog, rain, or snow to Buffalo, Pittsburg, Knoxville, and Chattanooga frequently descend as clear, dry winds on the eastern slope. The increase of temperature in these cases is not great.

The dry Chinook is a peculiar one. In the dead of winter it blows down from the mountains and high plateaus, where ice and snow are supposed to predominate, as a hot, dry wind upon the foothills and valleys below. Its effects are striking. The snow at these lower elevations, at first blown hither and thither by the increasing wind velocity, soon becomes moist and heavy under the influence of the blasts of hot air, and in an incredibly short time may entirely disappear. The temperature rises with astonishing rapidity and the whole aspect of nature is transformed. The arrival of the Chinook bears no relation to the shining of the sun, as it comes as frequently in the coldness of

[1] Monthly Weather Review for 1897, p. 545.

night as in the warmth of midday. It puts in check the boreal blasts of winter and affords a most welcome relief from the monotonous cold and snow characteristic of mountain winters in high latitudes.

BENEFICIAL INFLUENCE OF CHINOOK WINDS.

The climatic influences of the dry Chinook are important. In the region of its occurrence east of the Rocky Mountains it has, more than any other single cause, a modifying effect on the severity of winter. Were it not for the visitations of this warm, dry wind the vast stock ranges of Montana, Wyoming, and the Dakotas would have to be abandoned in the winter, as the cattle and other stock, prevented by the snow from securing access to the nutritious grasses on the plains, would not be able to secure nourishment sufficient to sustain life. According to the testimony of stockmen in this region, the advent of the Chinook at a critical period is often the means of saving their herds not only from starvation but from freezing. Instinctively, the cattle seem to anticipate its coming, and in times of cold and hunger may be seen standing knee-deep in the snow with their heads turned toward the mountains, anxiously awaiting the arrival of relief. Mr. A. B. Coe, voluntary observer of the Weather Bureau at Kipp, Mont., states that were it not for the Chinook wind the northern slope country of Montana would not be habitable, nor could domestic animals survive the winters.

Aside from its temperature, the Chinook bears an important relation to the amount of snow remaining on the ground in the mountains and on the plains at the time of the spring thaws. If the Chinook has been absent, or infrequent in occurrence, the accumulated snow, especially on the plains, is likely to be great. The conditions are then ripe for high spring floods. If frequent visitations of the Chinook have occurred, much of the snow on the plains will have either disappeared through evaporation or been converted into a hardened mass of snow and ice. As ice it remains a long time unmelted in the ravines and affords an abundant supply of water for the creeks and rivers during the succeeding spring and early summer. In either event the danger from floods from this source is practically eliminated. It might appear at first thought that these hot winds, which so suddenly denude the plains of snow, would themselves cause floods. Such is not generally the case. These winds are intensely dry, having lost their moisture on the other side of the Divide. Accordingly, they reach the eastern slope bereft of their original dampness, but possessing a manifold capacity for absorbing moisture from any source available. The melting snow supplies this source, and so rapidly does the evaporation follow that floods caused by the Chinook alone are practically unknown. Mr. Pague states that the influence of the Chinook

wind removes great quantities of snow from the foothills and lower mountains during the winter season, and an absence of the Chinook will cause much of the snow that falls in winter to remain unmelted until spring.[1] Such snow packs, hardens, and becomes a greater mass, for each new fall of snow adds to that which has already fallen. He also states that the floods in the Columbia River do not depend so much on the total precipitation of winter as upon the amount of snow in the mountains when the spring thaw begins.

CHANGES IN TEMPERATURE CAUSED BY CHINOOK WINDS.

In Montana the approach of the Chinook is marked by a falling barometer. The winds are light, the sky cloudless, and the air clear and cold. The first signs exhibit themselves on the mountain tops, where horizontal streamers of clouds unfurling along the summits afford a sure indication of the approach of the warm air from the region of high pressure beyond. The clouds thus appearing on the mountain tops are followed by cumuli, which, rolled up in huge billowy masses, soon hide the crests of the mountains from the observer in the foothills. The current of air, warming up by compression as it descends, quickly evaporates its own cloud particles, and from this stage downward it warms with great rapidity. As a rule, the Chinook reaches the lower levels with considerable velocity, depending apparently in a large measure on the steepness of the barometric gradient existing between the neighboring areas of high and low pressure. When the gradient is steep the Chinook comes with a rush and a roar, blowing the snow before it. Its velocity is frequently equal to that of a gale. On account of the heat the snow soon settles and melts, and in a few hours becomes compact ice in the ravines, but may entirely disappear in the open. At other times the advent of the Chinook is less violent. The breeze is a gentle one and comes in light puffs, blowing the snow about in a fantastic manner, as before. Eventually the wind increases in force, but rarely changes its initial direction. It is not an uncommon winter experience, in regions where the Chinook occurs, to retire at night with a temperature well below freezing and several inches of snow on the ground only to awaken the next morning to discover the snow all gone and the thermometer 40° or higher.

The rate and the amount of temperature change vary, the distribution of atmospheric pressure being the controlling factor. A rise of 20° to 40° in ten or fifteen minutes frequently occurs, although the change is not always so great. The table following shows the temperature at the stations named on the mornings of January 9 and 10, 1894, between which periods a Chinook wind prevailed over the territory represented

[1] Monthly Weather Review for 1899.

by these stations. The data are taken from the Weather Bureau records.

Changes in temperature at Weather Bureau stations during a Chinook wind.

Stations.	Temperature 8 a. m. January 9, 1894.	Temperature 8 a. m. January 10, 1894.	Change in 24 hours.
	° *F.*	° *F.*	° *F.*
Roseburg, Oregon	34	44	+10
Portland, Oregon	34	42	+ 8
Fort Canby, Wash	38	42	+ 4
Seattle, Wash	32	40	+ 8
Walla Walla, Wash	28	46	+18
Spokane, Wash	14	34	+20
Helena, Mont	10	38	+28
Miles City, Mont	− 6	40	+46
Havre, Mont	20	32	+12
Bismarck, N. Dak	−22	32	+54

During this period a high pressure with a reading of 30.7 inches was central over Nevada, and a low pressure with a reading of 29.8 inches over northern Montana.

In his report for November, 1896, the section director of the Idaho climate and crop service states that during the latter part of the month the State was visited by a succession of Chinooks which raised the mean temperature above normal and gave everything a spring-like appearance. In many places plowing was begun. The average temperature for the last half of the month was 12° warmer than the first half. In Montana during the same month the temperature rose from 6° to 40° in two hours at Dillon on the 16th; at Red Lodge from −21° to 21° in one hour; at Kipp on the 17th from 11° to 21° in nine minutes, and at Lewistown on the same date from 10° to 30° in three hours. At Great Falls, Chinook winds blew continuously on the 13th and 14th and up to 12.25 p. m. of the 15th, when a sudden change in temperature, but not in direction of the wind, occurred. The temperature dropped in a few minutes from 44° to 23°, but a few hours later rose to 54°, after which it fell gradually to 19°. These rapid fluctuations, characteristic of the Chinook, are not well understood, but are supposed to be due to the surging back and forth of the currents of cold and warm air.

CONDITIONS ACCOMPANYING SOME WELL-DEFINED CHINOOKS.

Following the warm weather of November, 1896, came a series of snowstorms and cold waves of great intensity for the season. The effect on grazing cattle in Montana was especially severe. Thousands of the helpless beasts wandered aimlessly over the hills searching in vain for food and shelter. As the days went by and no relief was

afforded, their safety was a question of great moment. No food was obtainable, for the grasses upon which they were wont to subsist lay buried under 30 inches of snow. On the evening of December 1, 1896, the temperature at Kipp, Mont., was -13°. The air was scarcely moving and the sky was clear. Suddenly over the edge of the mountains in the southwest appeared a great bank of black clouds, their outer edges blown into tatters by the wind. In a few minutes a short puff of hot dry air had reached the plains and in the following seven minutes the temperature had risen 34°. The wind increased in velocity to 25 miles and the temperature rose to 38°. Within twelve hours every vestige of the 30 inches of snow had disappeared, leaving the hills bare and the plains covered with water.[1]

Chinook winds with temperatures generally above freezing occurred over Washington, Oregon, Idaho, and Montana on December 2, 3, and 4, 1896. These winds were caused by the presence of a high pressure central over Utah and a low area moving along its northern edge. The winds in this instance are reported to have cleared the snow blockades which had closed the railroads and to have removed the snow from the stock ranges. On December 3, the Portland, Oregon, forecast official predicted warm Chinook winds for Washington, Oregon, and Idaho, a prediction verified by events.

These warm winds do not always closely follow the mountain slopes, but may take a gentler decline and reach the earth at a distance of a hundred or more miles from the base. When this happens, a well-defined Chinook with moderate temperature may be in existence high up on the mountain and farther away on the plains, while between them, near the foot of the mountain, the temperature may be at zero, or below. The following is an example: At Kipp, Mont., elevation 4,400 feet, on February 13, 1897, at 8.15 p. m., the temperature was 6°, wind northwest, weather clear, and 7 inches of snow on the ground. Thirty-eight miles away, at Summit, Mont., altitude 5,500 feet, at the same time, the temperature was 39°, with southwest winds and dense clouds. Three feet of snow was on the ground, but melting rapidly. The Chinook had prevailed for thirteen hours, yet had not reached 38 miles below. Two days later the temperature at Kipp rose to 40° in twelve minutes. In many instances of record the weather has been warm and spring-like near the summit of the mountains, while a cold wave has raged in the valleys below. Travelers who cross the Rocky Mountains in Montana in winter often meet with this phenomenon. Mr. E. J. Glass; section director of the Montana climate and crop service, in a paper on the "Chinook wind" delivered before the convention of weather bureau officials at Milwaukee, Wis., in August, 1901, cited an instance of an eastbound Northern Pacific passenger

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[1] See Montana Weather Report for December, 1896.

train leaving the summit of the pass with weather mild and the temperature above freezing. A half hour later the train had descended into a cold wave where the temperature was —13°. He states that conditions similar to this frequently exist between Helena and a voluntary station a few miles away and of slightly greater elevation. During the coldest weather of the winter of 1898 at Helena, the temperature at the mountain station was about 32°.

On December 4, 1897, an extensive Chinook was recorded. Its influence was felt as far east as Iowa, where the temperature rose suddenly in the night 12° to 14°. On this date the pressure was 30.7 inches over Utah and 29.7 inches over Manitoba, thus creating a strong indraft of air toward the latter place. In this instance the

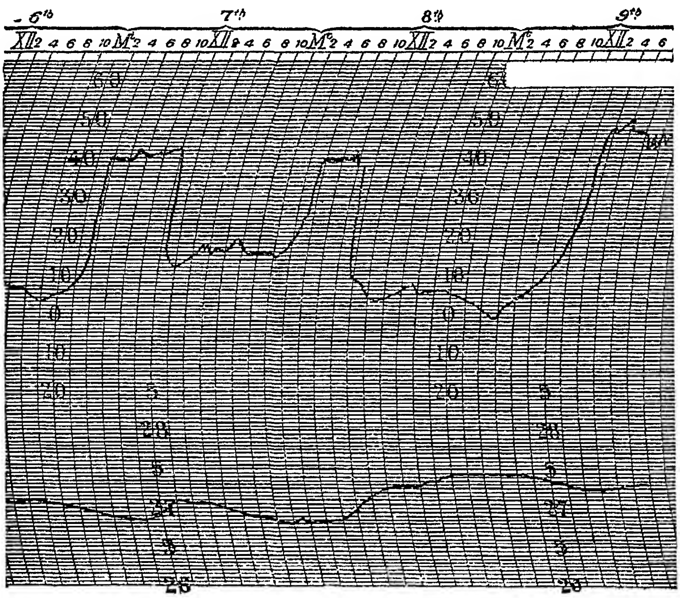


FIG. 45.—Variations in temperature and pressure at Havre, Mont., during a Chinook, March 7–9, 1900, as shown by automatic recording instruments.

eastward flowing air probably remained close to the ground and did not rise until near the Lakes. Similar conditions prevailed on December 29, 1897, temperatures in Minnesota, Iowa, and Wisconsin being from 20° to 50° warmer than on the day preceding. At the same time Chinook winds were felt in Washington and Oregon, as well as in the immediate mountain country east of the Continental Divide.

The Weather Bureau records for Havre, Mont., furnish a number of instances of rapid variations in temperature. On December 18, 1898, in the afternoon the temperature was 45°; at 4 the next morning it was 18°. During the next two hours there was a gain in

temperature of 6°, and in the following ten minutes a rise of 20°. Half an hour later the temperature fell to 30°, only to bound back to 44° at 7.30 a. m. On March 7, 1900, the temperature at this place rose 31° between midnight and 4 a. m. It remained stationary until 10.30 a. m., when in three minutes it decreased from 44° to 18°, and twenty minutes later registered 11°. The variations until 3 a. m. the next day were slight, when a rapid rise in less than an hour carried the temperature back to 40°, only to fall again a few hours later to 9°. The wind during this entire period was from the south or southwest. Figs. 45 and 46, showing the automatic records taken by the thermographs and barographs at Havre, Mont., and Williston, N. Dak.,

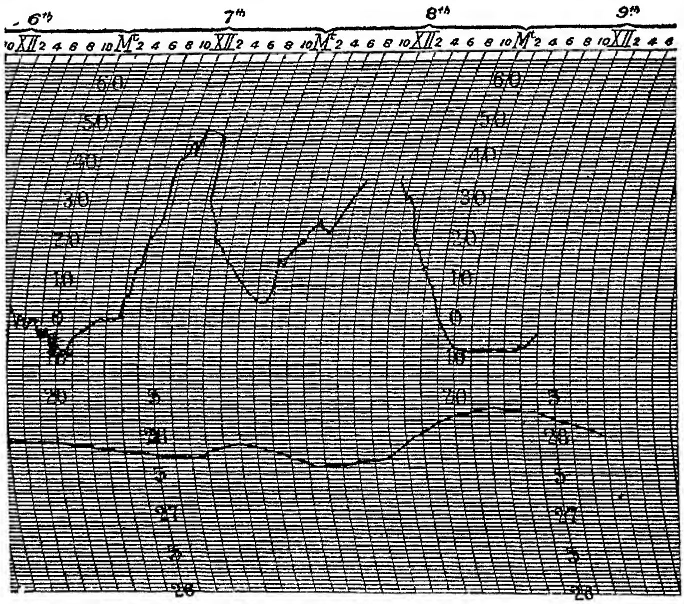


FIG. 46.—Variations in temperature and pressure at Williston, N. Dak., during a Chinook, March 7–9, 1900, as shown by automatic recording instruments.

during this period, may give a clearer conception of the facts. The upper lines are the thermograph traces and the lower lines the barograph traces.

Among other dates upon which well-defined Chinooks occurred may be mentioned January 14–18, 1899; December 21–25, 1899; and February 24–25, 1901. Perhaps the instances already given are sufficient to afford a general idea of conditions accompanying a Chinook. It is found by an examination of the weather maps of conditions prevalent at the time of Chinooks that certain barometric relations are usually present. Fig. 47, which is the weather map for the morning of December 4, 1897, may be taken as a fairly typical representation of the distribution of pressure and the resultant winds at such a time.

It will be observed that the high pressure, or anticyclone, is central over Utah, while the low pressure, or cyclone, is over Manitoba. The air, obeying natural laws, flows from the area of high pressure over the mountains to the low pressure. Emanating from the high plateau region of northern Nevada, Utah, and southern Idaho, it flows up and over the ranges to the northward and down the other side. In Oregon and Washington the resultant winds are from the south or southeast, while east of the Rocky Mountains the direc-

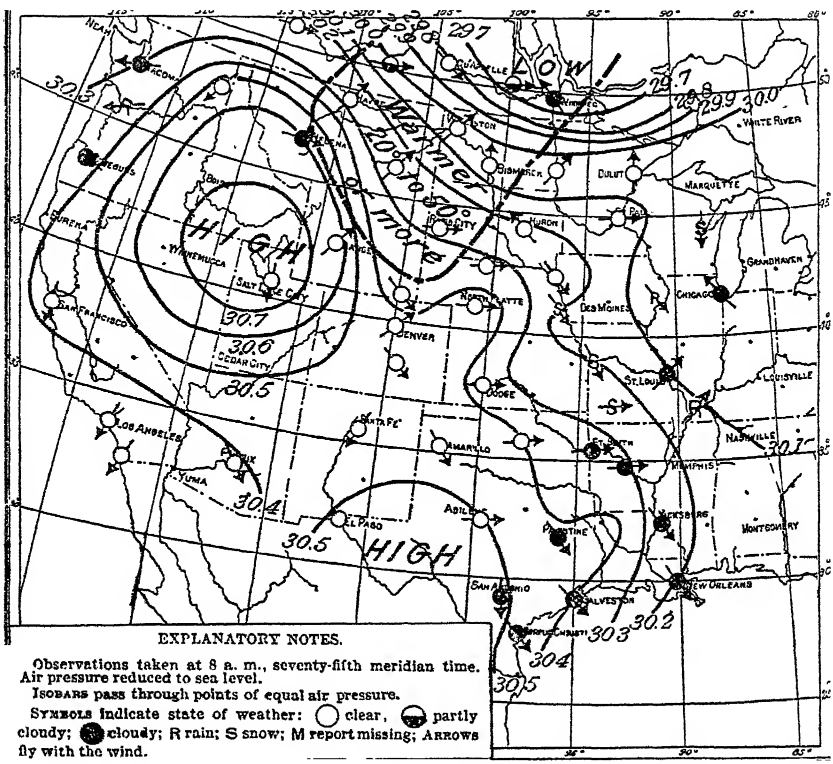


FIG. 47.—Weather map for 8 a. m., December 4, 1897, showing the typical distribution of pressure and attendant increase of temperature during a Chinook.

tion is from the south or southwest. In each case the air reaches a lower elevation than it possessed on the plateau. In doing so it must undergo compression and its temperature is raised accordingly.

DISCUSSION OF CONDITIONS PRODUCING CHINOOKS.

It is a well-established principle of physics that air, if caused to ascend, expands as it rises. As the expansion proceeds heat is used in doing work against the outside pressure, and the temperature is accordingly lowered. This process, known as dynamic cooling, proceeds at a perfectly definite rate, being 1.6° for each 300 feet of

ascent, provided no condensation takes place. It is found that the capacity of air to retain vapor diminishes as the temperature is reduced. Ascending air soon reaches a point where its capacity is taxed to the utmost, and if further ascent occurs condensation takes place and the air current becomes cloudy. This has an important effect on the rate of cooling, as the condensation of water vapor liberates latent heat. The decrease of temperature with ascent is then lowered at a rate depending upon the temperature of the air when condensation commenced, and upon the pressure. At a pressure of 30 inches and a temperature of condensation of 10° the fall in temperature is at the rate of 1.2° for each 300 feet; at the same pressure and a temperature of condensation of 30° the rate is 1° for each 300 feet; at a pressure of 22 inches and a temperature of condensation of 10° the rate is 1.1° for each 300 feet; and at a temperature of condensation of 30° it is 1° for each 300 feet. At the freezing point, moist air ascends for a short distance without loss of temperature, the energy required to maintain the increased volume being supplied by the latent heat derived from the conversion of water particles into ice. Apply these facts to Chinook winds. Suppose an area of high pressure over Montana and the Dakotas, with the temperatures ranging below zero. Let a low area appear off the British Columbia coast and at the same time a second high area move in from the upper California coast. The Dakota storm will move eastward, as will also the low in British Columbia and the high in California, the latter tending to assume a stationary position over Utah, while the low skirts its northern periphery. It is while this movement is in progress that Chinook conditions prevail. Warm, dry air is fed into the low from the high, and this process continues until stronger atmospheric forces break up the combination. This period is not likely to extend, however, beyond two or three days, and may be much less.

The temperature changes that occur in this system are worthy of note. The average temperature of the January highs entering the United States from upper California is about 44°. In passing over the mountains into the region of northern Utah the moisture is precipitated as rain or snow, and the temperature suffers a decrease to about 5° or 10°. The elevation of the plateau country is from 4,000 to 7,000 feet. The Willamette Valley and the Puget Sound region have elevations but slightly above sea level. In the valley of the Columbia the elevation nowhere exceeds 1,000 feet, while east of the Rocky Mountains the elevation gradually decreases from 4,000 to 2,000 feet. The summits of the mountains vary from 5,000 to 8,000 feet. In view of these topographical conditions, the reason for the warm wind down the mountain slopes is apparent. As the air is pushed out of the anticyclone toward the low it finds its way blocked on every side. It is literally hemmed in. The downward movement of the air over the

center of the anticyclone pushes the air out below and compels it to flow up over the mountains, cooling as it goes. The dew point is soon reached, and clouds are formed, followed by snow. As a consequence, when the air reaches the summit of the mountains its temperature is lower and the absolute amount of moisture it contains is less than before, but it has retained most of the heat evolved by the condensation. In descending the other slope the clouds which were formed on the windward side rapidly dissolve as the temperature rises, and the capacity of the air for moisture consequently increases. In the ascent, on account of the latent heat liberated by condensation, the rate of decrease of temperature is less than the normal rate. In the descent on the other side the dew point of the almost dry air is soon reached and passed. From this point downward the increase is at the normal rate, there being a net gain of about 0.5° for each 300 feet. Thus, it will be seen that stations having the same elevation on different sides of a mountain range will have different temperatures, where the air blows from one over the range to the other. When it is remembered that the eastern half of Montana and the Dakotas is several thousand feet lower than the plateau region where the high pressure is centered, the reason for the warm, dry southwest wind over these States becomes apparent. The contrast is made the greater because of the low temperature existing east of the mountains before the advent of the Chinook.

These Chinooks, therefore, need for their production an area of high pressure and an area of low pressure so located that the winds in being drawn out of the high into the low will be compelled to pass over an intervening mountain range. Owing to the location of the path of the storm tracks, the winter season is the time of the greatest number of Chinooks. During this period the daily chart of reduced pressures shows a tendency of high pressure to pile up over the plateau region. This is known as the continental high of midwinter. Anticyclones drifting eastward from the Pacific Ocean along the forty-first parallel become stationary over Utah, where they persist until borne away by a superior high over Montana or under some circumstances until disintegrated. In summer the storm tracks are different and few high areas pass over Utah. The Chinook winds in the Northwestern States are accordingly rare at such a time.

THE SOUTHEASTERLY CHINOOK WIND.

Two of the winds known as Chinooks have already been described. The third, a southerly or southeasterly wind, west of the Cascade Mountains, is not so generally recognized as a Chinook, and it is only in the last decade that this appellation has been applied to it. It has several of the characteristics of the wet Chinook from the ocean and the dry Chinook farther east. It is described by Mr. Pague in his

pamphlet on "Weather forecasting on the Pacific coast," and also by Mr. S. M. Blanford in an appendix to that pamphlet. Mr. Pague holds that this wind is originally a dry descending wind, due to the outflow from a high area in Utah. He attributes its high temperature to compression after the moisture has been lost in the plateau regions. The fact that near the ocean it is a wet wind and frequently followed by rain, has led to the assumption that the descending current becomes mixed with the humid air from the ocean. This is hypothetical, and further investigation may yield a different explanation.

The temperature changes accompanying this wind are neither so strong nor so sudden as in the case of the dry Chinook. One reason for this is found in the fact that the winter temperature west of the Cascade Mountains is relatively high and long periods of severely cold weather are rare. However, its effect is not inconsiderable. Mr. Pague, in "The mild temperature of the Pacific Northwest and the influence of the Kuro Siwo," claims that the influence of this southeasterly Chinook wind has a greater effect on the winter climate of the Pacific Northwest than does the adjacent ocean. This view may, perhaps, give undue weight to dynamic heating, as the ocean is thought to be the predominating factor in determining the winter climate of this region. A better understanding of the effect of the Chinook wind on winter weather can be had by considering it divorced from oceanic influences. This is the case east of the Cascade Mountains, and in Idaho, Montana, and Wyoming. Here the winters are generally severe, broken intermittently by visitations of the Chinook wind.

CONCLUSION.

As stated in the beginning of this paper, all three Chinook winds possess high temperatures. One is moist and may be followed by rain. It occurs only near the ocean. Another is a dry wind, and rain seldom follows for some time after its occurrence. The third wind occupies an intermediate stage, and, from the present knowledge of it, seems a combination of the other two. From November to March these Chinooks play an important part in determining the character of the weather in the Northwestern States. They are active agents in tempering the severity of the winter. When they arrive cold waves vanish, the snow disappears, and a short period of bright, balmy spring-like weather ensues. The Chinook aids the railroads in keeping their tracks clear of snow, enables the stockmen to bring their cattle safely through the winter, and stores up water in the form of ice for future use, making irrigation in the summer possible. It is an ever-welcome guest, whose coming is indicative of good, and whose absence would be a momentous evil.

WHEAT PORTS OF THE PACIFIC COAST.

By Edwin S. Holmes, Jr.,
Field Agent, Division of Statistics.

INTRODUCTION.

The attention of commercial nations is undoubtedly being attracted toward the Pacific coast, and as a consequence that section of the United States is rapidly developing in its commercial relations with the people of other countries. The wealth and resources of the Pacific coast are already being vastly augmented through its foreign trade, and it is quite probable that in the near future the western coast of the United States will be the scene of a very considerable proportion of the world's commerce.

The past year has witnessed a great expansion of trade with the Orient, South America, Australasia, East Indies, and the Southern Pacific Islands, and it is probably true that the capacity of this trade for future development is only just beginning to be appreciated.

The commerce of the Pacific coast has been increasing since the close of the Spanish-American war at a rate that can scarcely be credited. The United States will probably control the trade of the 8,000,000 inhabitants of the Philippine Islands, a trade amounting to over $60,000,000 yearly, and it will undoubtedly have a steadily increasing share of the $1,000,000,000 or more of annual foreign trade of China, Japan, and the Dutch East Indies.

An important factor in the development of the trade of the United States with Eastern countries is that the goods it exports (or sells) to them do not compete to any considerable extent with their domestic products. We furnish them with wheat, flour, cotton, tobacco, lumber, iron, implements, and machinery, and receive in exchange silks, tea, coffee, spices, mattings, and numerous other products peculiar to those countries.

There is in the Philippines, where navigation lines from the Pacific coast ports and Australasia converge, an important base of operations at the door of all the countries of the East. This fact alone would make the Orient the natural market for the products of the Pacific coast, and already offers an opportunity for a large and remunerative trade, a trade that is constantly increasing and is very different from that of

the Atlantic coast, whose shippers must necessarily take their wares to all the markets of the world and compete for the trade with the principal countries of Europe.

CUSTOMS DISTRICTS OF THE PACIFIC COAST.

There are nine customs districts on the Pacific coast of the United States, exclusive of Alaska and Hawaii, namely, Arizona; Humboldt, Los Angeles, San Diego, and San Francisco, California; Oregon, Southern Oregon, and Willamette, Oregon; and Puget Sound, Washington. Many fine harbors are situated within these districts, but the exports of wheat are practically confined to the ports of San Francisco, Portland, and the Puget Sound ports of Seattle and Tacoma.

SAN FRANCISCO.

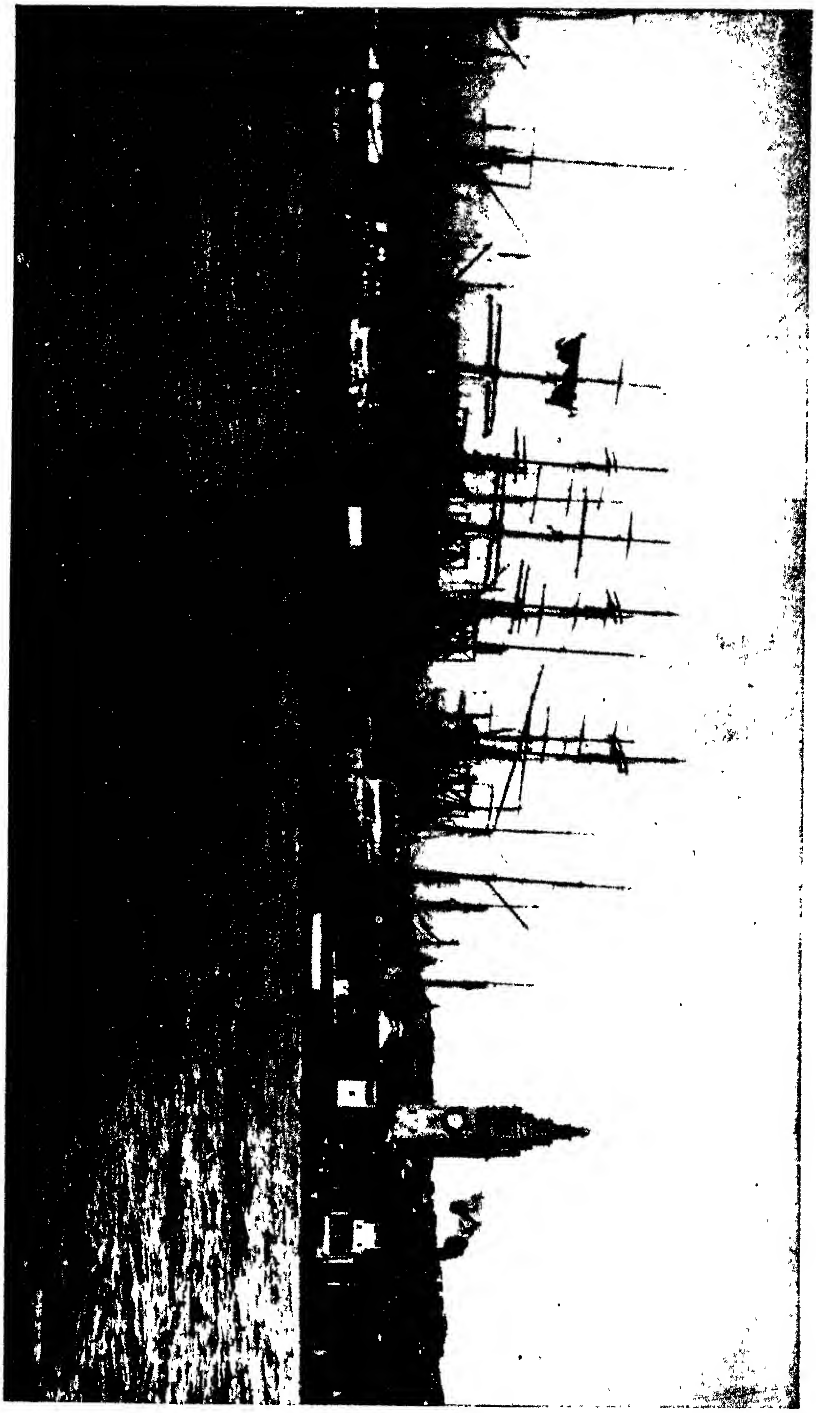
San Francisco is situated on San Francisco Bay, which, including the tributary bays, San Pablo and Suisun, constitutes one of the largest and safest harbors in the world. Its entrance, which is called the Golden Gate, is about 1 mile wide, and the channel has a depth of from 30 to 50 feet, which is ample to admit the largest ocean vessels. The bay widens rapidly inside the Golden Gate until it covers an area of about 460 square miles, with a shore line more than 300 miles in length.

The harbor of San Francisco possesses many attractions for vessels awaiting orders or repairs. Sausalito, Oakland, and Mission Bay offer safe anchorage out of the regular course of vessels, and repairs of any nature can be promptly made at any of the ship wharves and dry docks with which this magnificent harbor is amply provided, most of which possess facilities for handling the largest vessels. The warehouse accommodations of this port are ample, and vessels can receive and discharge cargoes with the greatest facility.

San Francisco is very favorably situated for trade with the Orient, being but 91 miles away from the shortest sailing route from the Isthmus to Yokohama, and within about 200 miles of the shortest route between the Isthmus and Hongkong.

All these advantages have combined to make San Francisco an attractive port for the shipping of all nations of the world, and vessels representative of all nationalities may be found in her harbor at any time. (Pl. LXXXII.)

Warehouses and docks.—San Francisco has naturally grown to be the great receiving point for most of the grain of California that is sent to tide water for further distribution, and the great grain warehouses of the city are located along the bay. Up to 1881 the warehouse accommodations of San Francisco were extremely limited, the only facilities for the storing of grain being located at Long Wharf, in Oakland, and Long Bridge, in San Francisco. At the present time,



WATER FRONT OF SAN FRANCISCO, CAL.

[Photograph furnished by the San Francisco Commercial News.]

however, the south banks of the Straits of Karquines, connecting San Pablo and Suisun bays, are built up for several miles with vast grain warehouses and docks, having a capacity for storing 380,000 tons of grain, equal to more than 12,500,000 bushels.

The most modern and extensive specimens of the warehouse property of San Francisco Bay are located at Port Costa. These warehouses include extensive wharves capable of handling the loads of eight or nine of the largest vessels at one time, and the depth of water at this point is such that if necessary vessels can be loaded to 30 feet draft.

Railroad tracks along the docks are elevated, so that wheat, when it does not require grading, may be loaded directly from car to ship without the use of hoisting machinery, thus reducing the labor cost to a minimum. The utmost care has been given to the ventilation of these warehouses; storage and insurance rates are low, and the warehouse capacity of Port Costa is therefore frequently taxed to its utmost during the greater part of the shipping season.

Some idea of the enormous amount of business transacted at this point may be gathered from the fact that by far the greater part of the wheat cleared at San Francisco, probably 90 per cent, is received and loaded at Port Costa.

Grader.—At Port Costa is located the grader, which is fitted with every facility for grading and recleaning wheat, and has an ample capacity for the expeditious handling of the enormous quantity of grain that is graded there.

Dry dock.—At Hunters Point, San Francisco, is located a stone graving dock, 498 feet long and 90 feet wide, capable of caring for the largest sailing vessels. The company owning this dock also maintains two floating docks, with a capacity for docking vessels of 3,000 tons. They have also in course of construction a new stone dock which, when completed, will be one of the largest and most commodious graving docks in the world, capable of handling the largest steamer afloat. When completed it will be 750 feet long, 122 feet wide at the top, and 74 feet at bottom, with a depth of 30 feet at high water. It will also be well provided with wharf approaches, and facilities for filling and emptying will be of the most modern pattern. The completion of this dock will materially add to the serviceability of the harbor of San Francisco, and will doubtless prove another attraction for the vessels of all nations.

PORTLAND.

The largest port in the State of Oregon is Portland, which in addition to the advantages of possessing a fresh-water harbor and an unobstructed channel to the sea, is one of the most important railroad terminals on the Pacific coast; it also possesses unexcelled facilities for the securing of an enormous river traffic.

Recognizing the great commercial importance of maintaining the open waterway from Portland to the coast, 120 miles distant, the Federal Government has recently built a jetty at the mouth of the Columbia River, the completion of which was followed by a water depth of 31 feet at mean low tide at the entrance to the river. This improvement has made it possible for vessels of 25 feet draft to reach the Pacific Ocean from Portland without lightering and without delay en route, as is evidenced by the fact that not a single one of the 128 ships comprising the Columbia River grain fleet of the season of 1901 was obliged to lighter any portion of its cargo between Portland and the sea. (Pl. LXXXIII.)

Constant improvements are being made in the channel of the lower Columbia River, and a regular tax for the prosecution of this work, under the direction of the port of Portland, is annually levied on the property of Portland and on that part of Multnomah County lying close to the sea.

Warehouses and docks.—The increasing demand for wharfage and shipping facilities consequent upon the growth of Portland's maritime commerce has been steadily met, and to-day Portland's 16 grain and flour warehouses cover about 8 miles of water front and have a storage capacity of 224,500 tons, or about 7,500,000 bushels. These docks are arranged parallel with the river and are built in two tiers for convenience in handling produce at either high or low water. They all have railroad trackage rights upon the land side, so that the grain and flour can be taken from the cars and loaded upon the ships simply by truckage across the warehouse, which is done when the grain is not stored and does not require grading.

From the water side of the warehouse the grain is ordinarily loaded into the holds of the vessels by the chute gravity system, and it is a common occurrence for ships carrying from 3,000 to 3,500 tons to be loaded in three or four days. In case of the cargo being upon the lower deck of the dock, and also in case of high water, wheat and flour are loaded up from the dock over the ship's side by means of patent electrical conveyors with a system of belts, which carry the bags along in rapid succession. (Pl. LXXXIV.)

All grain warehouses of this port are fitted with conveyors, cleaners, graders, smutters, etc., making each one practically an elevator.

Storage charges.—In the warehouse district 350 cars of wheat can easily be placed in storage in the course of a day. The usual charge for storage is 60 cents per ton, sixty days, which price includes all labor, truckage, unloading from the cars, and loading upon the vessels.

Cargoes.—Portland made some new records in size of cargoes during the past season. The steamer *Thyra*, for instance, in May took a cargo of 51,931 barrels of flour and 1,000 tons of miscellaneous

FIG. 1.—PORTLAND (OREGON) HARBOR, SHOWING A PORTION OF THE GRAIN FLEET.
[Photograph furnished by the Portland Oregonian.]

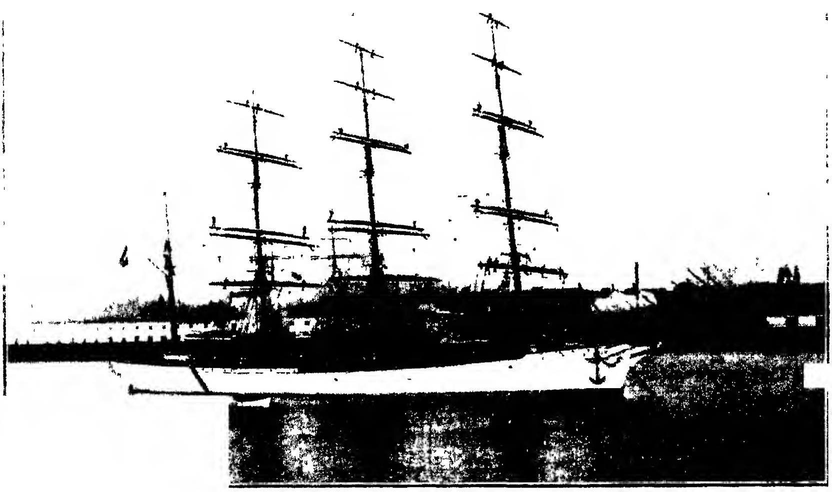


FIG. 2.—A TYPICAL SAILING VESSEL OF THE PORTLAND (OREGON) GRAIN FLEET.
[Photograph furnished by the Portland Commercial Review.]

ELECTRICAL CONVEYOR, LOADING 240-POUND SACKS OF WHEAT.

[Photograph furnished by Taylor, Young & Co.]

freight. This was the largest cargo of flour ever put afloat on the Pacific coast, and, with the exception of a cargo of 55,000 barrels once taken by a steamer from Newport News, was the largest flour cargo ever shipped by sea from any port. Another large cargo of 47,803 barrels of flour was taken by the steamer *Lenox*, and later in the season the *Abergeldie* took 46,899 barrels. These three cargoes represent a total of 146,633 barrels of flour, or an average of 48,800 barrels per cargo, a record that has probably never been surpassed by any port in the world.

Dry dock.—In recognition of the constantly growing importance of the maritime commerce of Portland, the Oregon State legislature at its last session empowered the commissioners of the port to build a dry dock of sufficient capacity to accommodate the largest vessels that enter the harbor.

The commission will spend not less than $400,000 on this dock, and when this one lacking item of harbor convenience shall have been completed, Portland will possess one of the best equipped harbors in the world. This port, in its fresh-water harbor, already has a strong inducement to the docking and repair of vessels, and when the proposed dry dock is in commission it will doubtless have no lack of remunerative business.

PUGET SOUND.

Puget Sound proper, as it is now known, includes all the waters of the great inland sea which lies east of the Straits of Juan de Fuca, and extends from the northern boundary line of the United States to Olympia, Wash. The waters of the sound are from 60 to 1,000 feet in depth and the rise and fall of the tide is from 9 to 18 feet. The sound contains no sunken reefs or other obstructions dangerous to navigation, and vessels of all sizes can safely enter it at any time.

The estimated area of Puget Sound is 2,000 square miles, and the coast line aggregates 1,800 miles in length, forming a vast harbor protected on almost every side by high mountain ranges, and of a capacity sufficient to shelter all the navies of the world.

Upon the eastern shore line of this remarkable body of water are situated the two great commercial cities of Washington—Seattle and Tacoma.

Seattle.

Seattle, the largest city in the State of Washington, is situated on Puget Sound, 129 miles east of the Pacific coast. It lies between Elliott Bay, an arm of Puget Sound, a little over 2 miles in width, and Lake Washington, a body of fresh water 22 miles long and from 2 to 4 miles wide. (Pl. LXXXV.)

The harbor of Seattle has many natural advantages. It can be entered safely, every day of the year, by vessels of any size, and is particularly favorably located for Alaskan and Oriental trades, which

have come to play a most important part in the development of the commerce of Seattle.

The climate of Seattle is all that could be desired in a commercial sense. Comparatively few extrémes of heat and cold are experienced. No ice forms in the harbor, and it is also remarkably free from foggy weather and excessive rains. This city also has a practically inexhaustible supply of coal at her very gates; this fact alone is of the greatest importance to both steamship and railroad companies, and will doubtless be a factor strongly favorable to the establishment of new lines of transportation, especially trans-Pacific steamship lines.

Warehouses and docks.—Seattle has 16 warehouse elevators an docks, with a capacity sufficient for the storage of 5,447,500 bushel of sacked grain. These warehouses, etc., are equipped with the lates devices for cleaning and grading the grain, and also with patent co veyors for loading vessels.

In addition to these, there are a number of smaller warehouses for storage of miscellaneous freight, which have a grain-storage capa of about 700,000 bushels. These warehouses are not included ir above estimate because of the miscellaneous character of the fre with which they are usually filled.

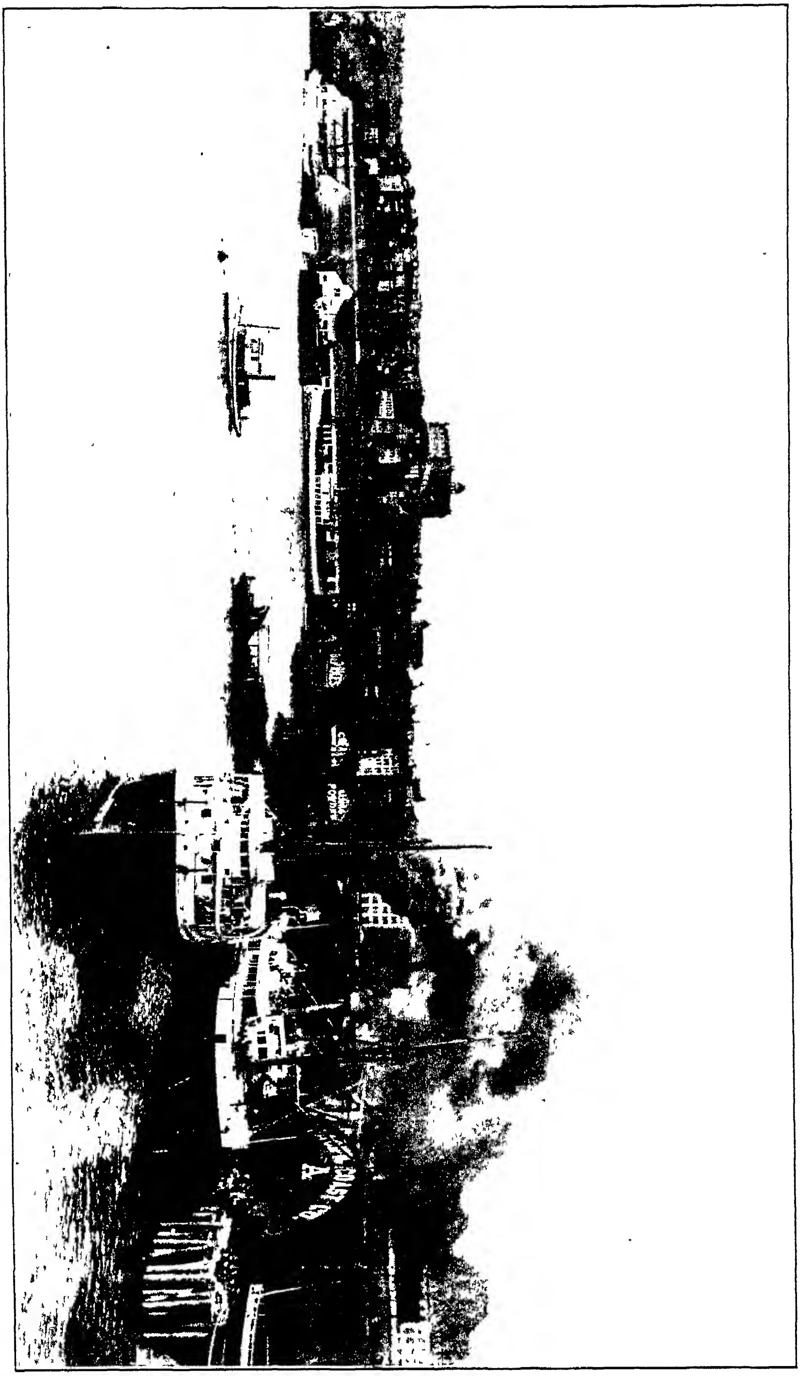
Tacoma.

Tacoma is situated upon Commencement Bay, a sheltered arm of Puget Sound. Commencement Bay lies 100 miles south of the Straits of Fuca, and is a perfectly landlocked harbor at the head of deep-water navigation on Puget Sound. (Pl. LXXXVI.)

A large share of the grain and flour exported from Puget Sound is loaded at Tacoma. During the past year many vessels left the harbor loaded with grain and flour for China, Japan, Siberia, South Africa, Europe, Hawaii, Alaska, and many ports in other regions.

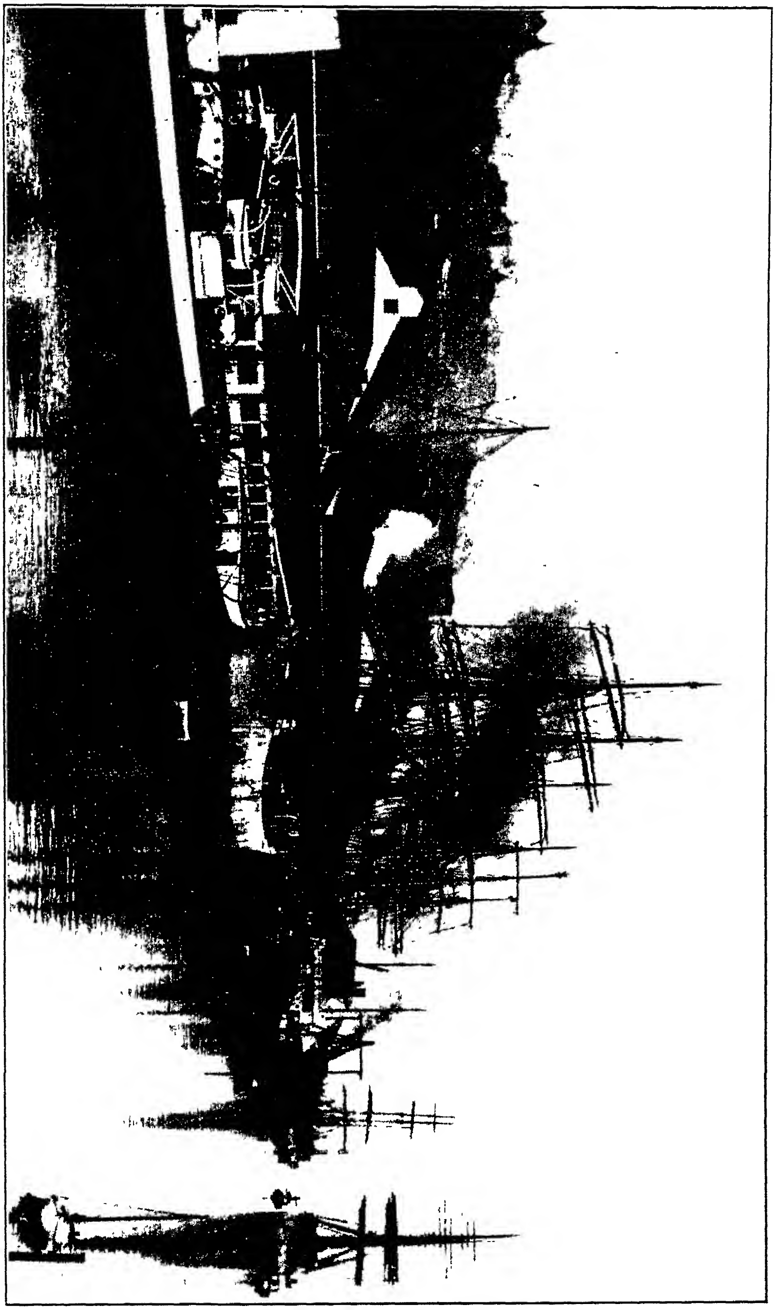
Warehouses and docks.—Within the past two years 4 new grain warehouses were constructed on the west side of the city waterway. These really form one continuous warehouse 2,240 feet long, and have practically doubled the wheat-storage capacity of the port, the total storage capacity now being 5,152,000 bushels, distributed between 7 warehouses and elevators. These warehouses are completely equipped with all modern devices for the cleaning, grading, and rapid handling of grain.

Dry dock.—The only dry dock on Puget Sound, with the single exception of the Government dock at Bremerton, is located at Tacoma. It is 325 feet in length and 80 feet wide, with a displacement of 8,000 tons, and is provided with the latest and most improved machinery. During 1890, 90 vessels, varying in size from 46 to 3,100 tons, with a total displacement of 81,683 tons, were overhauled at this dock.



PORTION OF WATER FRONT OF SEATTLE, WASH.

[Photo [illegible] the Chamber of Commerce.]



HARBOR OF TACOMA, WASH.
[From photograph by A. French.]

THE PACIFIC COAST GRAIN FLEET.

The records of the last ten years show that there are on an average about 333 vessels engaged in the grain trade of the Pacific coast. Of this number, 192 are cleared from San Francisco, Cal., 96 from Portland, Oregon, and 45 from the Puget Sound ports—Tacoma and Seattle, Wash.

The number of vessels engaged in the grain trade varies to a considerable extent from year to year, and is largely dependent on the amount of grain available for export and the kind of vessels engaged in the trade. (Pl. LXXXIII).

TYPES OF VESSELS.

Shipments of flour from Pacific coast ports are nearly all made by regular lines of steamers, but the great bulk of the wheat exported, practically all the grain in fact, is carried in sailing vessels. Occasionally, however, freight rates may be sufficiently high to warrant the chartering of steamers, which are generally of larger capacity than the sailing vessels. Sometimes also a steamer will have an order to proceed to some foreign port without a cargo, and rather than go back empty or in ballast it will take on a cargo of grain, and at a price even lower than the prevailing rate for shipments for the particular port for which the vessel is bound. Sailing vessels, however, are preferred by the majority of shippers, even though the freight rate is the same, and it is only in case of the shortage of sailing vessels that steamers are used to any considerable extent.

The following table shows the total number of vessels engaged in the grain-carrying trade of the principal ports of the Pacific coast during the past ten years:

Number of grain vessels cleared from the principal ports of the Pacific coast, 1892 to 1901.

Year ended June 30—	Vessels cleared from San Francisco, Cal.	Vessels cleared from Portland, Oregon.	Vessels cleared from Puget Sound, Washington.
	Number.	*Number.*	*Number.*
1892	273	86	48
1893	230	82	47
1894	189	69	40
1895	163	108	33
1896	208	69	30
1897	250	76	23
1898	215	136	71
1899	66	106	50
1900	162	98	35
1901	159	128	74

AMERICAN VS. FOREIGN SHIPS.

During the grain season the flag of nearly every nation on earth is represented at most of the Pacific coast ports. All styles of vessels are seen. Clippers, packets, schooners, barks, and other classes of vessels, from the largest modern steamers to the smallest ocean-sailing vessels, are constantly anchored in some of the many fine harbors of the coast.

The relative proportions of American and foreign vessels engaged in the grain-carrying trade of the Pacific coast vary somewhat from year to year, but on an average a little over 90 per cent of the total number of vessels employed in this trade are owned by foreign capital.

While it is impossible to state the number of American and foreign vessels engaged in each of the Pacific coast ports for a series of years, the relative proportions of such vessels engaged in the grain trade of San Francisco during the past ten years, shown in the following table, may be considered fairly representative of all wheat ports of the Pacific coast:

Number of American and foreign vessels engaged in the grain trade of San Francisco, 1892 to 1901.

Year ended June 30—	American vessels.	Foreign vessels.	Total.
	Number.	*Number.*	*Number.*
1892	39	234	273
1893	29	201	230
1894	26	163	189
1895	13	150	163
1896	13	195	208
1897	24	226	250
1898	8	207	215
1899	12	54	66
1900	3	159	162
1901	10	149	159

NATIONALITY AND TONNAGE OF VESSELS.

During the season of 1901, 361 cargoes of wheat were exported from the Pacific coast. Of the vessels engaged in this trade, 243, or 67.3 per cent, sailed under the British flag; 52, or 14.4 per cent, German; 35, or 9.7 per cent, French; and 10, or 2.8 per cent, American, every one of the American vessels having sailed from San Francisco. The remaining 21 vessels were of the following nationality: Italian, 7; Australian, 4; Chilean, Danish, Norwegian, and Russian, 2 each; and Dutch and Peruvian, 1 each.

Of the total number of vessels, 159, or 44 per cent, sailed from San Francisco; 128, or 35.5 per cent, from Portland; and 74, or 20.5

per cent, from the ports of Puget Sound. The total tonnage of these vessels amounted to 709,792 tons, divided as follows: From San Francisco, 324,947; Portland, 230,287; Puget Sound, 154,558.

As shown in the following table, the average tonnage of all vessels of the Pacific coast grain fleet of 1901 was 1,966. Vessels clearing from San Francisco averaged 2,044 tons; Portland, 1,799 tons, and Puget Sound ports, 2,089 tons.

Nationality and registered tonnage of vessels comprising the Pacific coast grain fleet of 1901.

Nationality.	Vessels cleared from San Francisco, Cal.		Vessels cleared from Portland, Oregon.		Vessels cleared from Puget Sound, Washington.		Total vessels cleared.	
	Number.	*Tons.*	*Number.*	*Tons.*	*Number.*	*Tons.*	*Number.*	*Tons.*
American	10	23,231					10	23,231
Australian	4	8,702					4	8,702
British	103	202,167	77	139,168	63	134,039	243	475,374
Chilean	1	768			1	768	2	1,536
Danish			2	3,042			2	3,042
Dutch			1	2,791			1	2,791
French	24	59,355	11	18,024			35	77,379
German	8	15,750	34	63,176	10	19,751	52	98,677
Italian	5	8,790	2	2,619			7	11,409
Norwegian	1	2,418	1	1,467			2	3,885
Peruvian	1	761					1	761
Russian	2	3,005					2	3,005
Total	159	324,947	128	230,287	74	154,558	361	709,792
Average		2,044		1,799		2,089		1,966

METHODS OF LOADING VESSELS.

Ships are often loaded directly from the car in which the wheat is transported to tide water. This method of loading is largely practiced at San Francisco and Port Costa, where the grain when received is generally very clean and where elevators, as commonly known in the East, do not exist, the greater part of the grain leaving these ports, except where grading is required, being shipped in the identical sack in which it was placed in the wheat field.

In Portland and the Puget Sound ports, however, the wheat, although it is brought to the shipping points in sacks, is more frequently run through an elevator, where it is recleaned and mixed with other grades of wheat to bring it to the required standard grade, after which it is resacked and loaded on vessels for final shipment.

The ordinary method of loading vessels, when the platform of the warehouse or dock is higher than the deck of the vessel to be loaded, is to place the sacked wheat on an inclined chute and allow it to descend by gravity into the hold of the vessel. It sometimes happens, however, that the wheat to be loaded is on the lower deck of the wharf and below the deck of the vessels, and in cases of this kind a conveyor, which

consists of a chute and an endless belt, is used, the wheat being laid on the belt, which runs up the chute and conveys the sack to the highest point, from which it descends by gravity to the hold of the ship. These conveyors are generally run by electricity, the necessity for the constant shifting of the chute prohibiting the use of steam. (Pl. LXXXIV.)

Practically all of the wheat exported from the Pacific coast is shipped in sacks, but very few vessels receiving bulk shipments. In loading sacked wheat for export a number of sacks in each row are "bled." In other words, a slit is made in the sack, which allows a small quantity of the wheat to escape and fill in the spaces around the corners and sides of the sack, thus making a more compact cargo, which is less liable to shift than would be the case if the sacks were loaded without "bleeding."

EXPORTS OF WHEAT.

The country tributary to the Pacific coast seaports raises about 65,000,000 bushels of wheat annually, about 37,000,000 bushels, or 56.9 per cent, of which are exported each year in the form of grain and flour. During the ten years ending with 1901 an average of more than 110,000,000 bushels of wheat were annually exported from the United States; of this amount Pacific coast ports shipped about 27,600,000 bushels each year, amounting to 25.1 per cent of the average exports from the United States, and valued at about $19,400,000.

Exports of wheat from the principal ports of the Pacific coast have fluctuated considerably during the past ten years, and have ranged all the way from 37,426,479 bushels in 1898 to 19,149,090 in 1899, these years being, respectively, the years of largest and smallest exports of wheat during the period.

In 1901 the total exports of wheat from the principal ports of the Pacific coast amounted to 34,926,188 bushels, valued at $20,911,456. Of this amount, San Francisco shipped 13,262,796 bushels, or 38 per cent; Portland, 13,044,008 bushels, or 37.3 per cent; and the Puget Sound ports, 8,619,384 bushels, or 24.7 per cent. The values of the above exports by ports were $8,233,916, $7,572,732, and $5,104,808, respectively.

The chief points of destination from San Francisco were Cork, South American ports, St. Vincent, and Liverpool, in the order named. Cork alone received 10,517,993 bushels, or nearly 80 per cent of the total shipment from San Francisco.

Of the grain shipped from Portland during the year, 10,981,000 bushels, or about 83 per cent of the total amount, went directly to the United Kingdom for further distribution, and the Puget Sound ports also shipped more than half of their total exports to that country, 5,062,950 bushels, or nearly 60 per cent, going directly there.

EXPORTS OF FLOUR.

Of the 16,432,175 barrels of wheat flour that were exported on the average from the United States during each of the past ten years, about 2,000,000 barrels, or a little more than 12 per cent, with an average value of nearly $7,000,000, were exported from the principal ports of the Pacific coast.

During the past ten years exports of flour from the Pacific coast have increased steadily and almost uninterruptedly from 1,497,879 barrels in 1892 to 2,736,313 barrels in 1901, an increase of 1,238,434 barrels, or nearly 83 per cent. Values have followed the course of prices, having increased from $7,126,629 in 1892 to $8,036,891 in 1901, and during the ten years ending with 1891 the average annual value of flour exported from the Pacific coast was $6,861,619.

During 1901 trade between Pacific coast ports and the Orient has made wonderful strides. China and Japan and other Oriental countries now receive more than 70 per cent of all the flour exported from the Pacific coast.

New lines of steamers have been and are being established especially for this trade. One recently established line of 11 steamers, which is now in full operation between Puget Sound and Liverpool, via Suez Canal, touches at Manila and all ports of the Straits Settlements, India, Arabia, Egypt, and Mediterranean and continental ports, and, by saving the transfer charges, enables the manufacturers of the country tributary to Puget Sound, especially the manufacturers of flour, to lay their products down in the ports beyond Hongkong at a rate per ton considerably less than has been possible heretofore. Puget Sound ports have taken the lead in the Oriental flour trade, having shipped during the past year 802,410 barrels to Oriental ports against 573,389 barrels from Portland and 553,803 barrels from San Francisco.

The tables following show in detail the exports of wheat and flour from the principal ports of the Pacific coast and from the United States from 1892 to 1901:

Quantity and value of wheat exported from the principal ports of the Pacific coast, 1892–1901.

Year ended June 30—	San Francisco, Cal.		Portland, Oregon.		Puget Sound, Washington.		Total.	
	Bushels.	*Value.*	*Bushels.*	*Value.*	*Bushels.*	*Value.*	*Bushels.*	*Value.*
1892	21,324,631	$21,583,410	5,072,005	$5,048,549	4,187,229	$4,068,163	30,583,865	$30,700,122
1893	17,620,762	13,849,095	5,004,202	3,705,878	3,783,781	2,745,722	26,408,745	20,300,695
1894	15,023,191	9,608,785	5,620,704	3,199,254	4,211,722	2,236,027	24,855,617	15,044,066
1895	15,993,717	8,601,473	8,989,443	4,231,956	4,002,015	1,813,526	28,985,175	14,646,955
1896	17,031,613	10,553,609	5,494,297	3,054,925	2,738,629	1,577,508	25,264,539	15,186,042
1897	16,460,629	12,610,605	6,154,970	4,577,670	2,456,931	1,972,238	25,072,530	19,160,513
1898	16,178,521	14,617,310	13,224,043	10,842,342	8,023,915	6,583,771	37,426,479	32,043,423
1899	3,794,890	2,709,995	9,945,183	6,231,978	5,409,017	3,432,450	19,149,090	12,374,423
1900	10,702,902	6,591,895	8,955,544	5,082,662	3,566,719	2,078,905	23,225,165	13,753,462
1901	13,262,796	8,233,916	13,044,008	7,572,732	8,619,384	5,104,808	34,926,188	20,911,456
Annual average.	14,739,365	10,896,009	8,150,440	5,354,795	4,699,934	3,161,312	27,589,739	19,412,116

Quantity and value of wheat flour exported from the principal ports of the Pacific coast, 1892–1901.

Year ended June 30—	San Francisco, Cal.		Portland, Oregon.		Puget Sound, Washington.		Total.	
	Barrels.	*Value.*	*Barrels.*	*Value.*	*Barrels.*	*Value.*	*Barrels.*	*Value.*
1892	1,056,057	$5,194,073	338,226	$1,492,873	103,596	$439,683	1,497,879	$7,126,629
1893	1,084,561	4,294,178	388,776	1,334,435	174,119	614,522	1,647,456	6,243,135
1894	784,672	2,642,067	300,585	818,315	277,173	753,242	1,362,430	4,213,624
1895	878,701	2,631,064	339,048	752,091	372,500	869,106	1,590,249	4,252,261
1896	954,500	3,121,868	560,233	1,433,401	402,489	1,090,935	1,917,222	5,646,204
1897	1,108,502	4,479,384	525,152	1,864,027	508,620	1,760,259	2,142,274	8,103,670
1898	802,223	3,643,467	638,172	2,475,918	615,155	2,294,642	2,055,550	8,414,027
1899	938,153	3,466,648	752,101	2,310,540	688,535	2,165,193	2,378,789	7,942,381
1900	1,069,966	3,517,681	792,416	2,153,945	1,037,583	2,965,746	2,899,965	8,637,372
1901	966,808	3,083,532	692,573	1,905,226	1,076,932	3,048,133	2,736,313	8,036,891
Annual average	964,414	3,607,396	532,728	1,654,077	525,670	1,600 146	2,022,813	6,861,619

Quantity of wheat and wheat flour (reduced to its equivalent in wheat) exported from the principal ports of the Pacific coast, 1892–1901.

Year ended June 30—	San Francisco, Cal.	Portland, Oregon.	Puget Sound Washington.	Total.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*
1892	26,076,887	6,594,022	4,653,411	37,324,320
1893	22,501,286	6,753,694	4,567,317	33,822,297
1894	18,554,215	6,973,336	5,459,000	30,986,551
1895	19,947,871	10,515,159	5,678,265	36,141,295
1896	21,326,863	8,015,345	4,549,829	33,892,037
1897	21,448,888	8,518,151	4,745,721	34,712,763
1898	19,788,525	16,095,817	10,792,113	46,676,455
1899	8,016,578	13,329,637	8,507,425	29,853,640
1900	15,517,749	12,521,416	8,235,843	36,275,008
1901	17,613,432	16,160,586	13,465,578	47,239,596
Annual average	19,079,229	10,517,717	7,065,450	36,692,396

Quantity and value of wheat flour exported from Pacific coast ports to certain Oriental ports in 1901.

Destination.	San Francisco, Cal.		Portland, Oregon.		Puget Sound, Washington.	
	Barrels.	*Value.*	*Barrels.*	*Value.*	*Barrels.*	*Value.*
Hongkong			410,094	$1,116,601	402,803	$1,149,705
Shanghai	[a] 453,626	$1,409,284	2,555	6,986	15,450	45,675
Yokohama	[b] 58,388	189,707	56,834	156,902	141,631	410,941
Kobe	36,244	125,139	21,407	58,502	46,412	135,992
Manila			250	750	3,000	9,000
Nagasaki			3,347	8,874	20,970	56,191
Hakodate			625	1,719	2,389	7,167
Moje			3,525	9,478	5,567	16,700
Singapore	5,545	19,408	1,000	2,651	500	1,500
Vladivostok			66,252	184,160	87,984	259,155
Port Arthur			7,500	21,200	75,704	220,982
Total	553,803	1,743,538	573,389	1,567,826	802,410	2,313,008

[a] All ports in China. [b] All ports in Japan.

Exports of wheat and flour from the United States, 1892–1901.

Year ended June 30—	Wheat.	Wheat flour.	Wheat and wheat flour reduced to equivalent in wheat.
	Bushels.	*Barrels.*	*Bushels.*
1892	157,280,351	15,196,769	225,665,812
1893	117,121,109	16,620,339	191,912,635
1894	88,415,230	16,859,533	164,283,129
1895	76,102,704	15,268,892	144,812,718
1896	60,650,080	14,620,864	126,443,968
1897	79,562,020	14,569,545	145,124,972
1898	148,231,261	15,349,943	217,306,004
1899	139,432,815	18,485,690	222,618,420
1900	101,950,389	18,699,194	186,096,762
1901	132,060,667	18,650,979	215,990,073
Annual average	110,080,663	16,432,175	184,025,449
Percentage from Pacific coast	25.1	12.3	19.9

FREIGHT RATES.

It is somewhat difficult to make an estimate of the average monthly freight rate between Pacific coast ports and the final destination of shipment, owing to the fact that vessels are frequently chartered at the beginning of the season or even before that date. In addition to this, tramp steamers and sailing vessels having a call from some other port, and being desirous of getting a load at short notice, frequently cut the rate; in a majority of such cases these rates are not published. Much of the grain exported from the Pacific coast goes directly to the United Kingdom for further orders, and the freight rate to the United Kingdom is therefore usually taken as the standard rate.

The season of 1901 has been a very good one for the owners of the ships comprising the grain fleet of the Pacific coast. At the beginning of the season, spot rates on grain shipped to the United Kingdom were about $9 per ton. During August and September the rate rose as high as $12.17, and the average rates for the entire year were as follows: San Francisco, $9.39; Portland, $9.81; and Puget Sound, $9.77.

The tables on the next page show, respectively, the average freight rate on grain from Pacific coast ports to the United Kingdom for each month during the season of 1901, the average highest and lowest rates from San Francisco during the same period, and the average annual rate from San Francisco to the United Kingdom from 1891 to 1900, in both wooden and iron ships. For the past four years, however, wooden ships have not figured to any extent in the grain trade of San Francisco. The last two tables show rates from San Francisco only, but these rates may be said to be fairly representative for all the ports of the Pacific coast.

Average ocean freight rate per ton on grain from Pacific coast ports to the United Kingdom, 1900–1901.

Month.	San Francisco, Cal.	Portland, Oregon.	Puget Sound, Washington.
	Per ton.	*Per ton.*	*Per ton.*
July, 1900	$9.12	$9.63	$9.41
August, 1900	9.43	9.39	10.14
September, 1900	10.48	9.85	9.79
October, 1900	....	10.08	10.12
November, 1900	10.61	9.51	10.08
December, 1900	9.45	10.58	10.50
January, 1901	9.31	10.06	9.27
February, 1901	9.37	10.14	9.87
March, 1901	....	9.85	9.67
April, 1901	8.19	9.87	9.77
May, 1901	8.80	9.59	8.91
June, 1901	9.12	9.27	....
Aver ge rate for the year	9.39	9.81	9.78

Average, highest, and lowest spot freight rates per ton on grain from San Francisco to the United Kingdom, 1900–1901.

Month.	Average spot rates.	Highest spot rates.	Lowest spot rates.
	Per ton.	*Per ton.*	*Per ton.*
July, 1900	$9.12	$9.12	$9.12
August, 1900	9.43	10.04	8.52
September, 1900	10.48	12.17	9.43
October, 1900	....	....	....
November, 1900	10.61	11.25	10.04
December, 1900	9.45	9.73	9.25
January, 1901	9.31	10.01	7.91
February, 1901	9.37	9.43	9.25
March, 1901	....	....	....
April, 1901	8.19	8.52	7.91
May, 1901	8.80	9.12	8.52
June, 1901	9.12	9.43	8.89
Average rate for the year	9.39	9.89	8.83

Average ocean freight rate per ton on grain from San Francisco to the United Kingdom, 1891–1900.

Year ended June 30—	Average ocean rate in wooden ships.	Average ocean rate in iron ships.
	Per ton.	*Per ton.*
1891	$9.45	$10.20
1892	7.77	7.56
1893	4.71	5.52
1894	6.14	6.71
1895	6.20	6.57
1896	6.57	6.45
1897	6.39	5.78
1898	....	5.03
1899	....	6.33
1900	....	9.10

THE TUBERCULIN TEST FOR TUBERCULOSIS.

By D. E. Salmon, D. V. M.,
Chief of the Bureau of Animal Industry.

IMMUNITY BY INOCULATION WITH BACTERIAL PRODUCTS.

In 1882 the writer became convinced from the experimental evidence at his command that certain disease germs produced a chemical substance during their growth and multiplication which, if injected into the tissues of an animal, would induce immunity from the disease that these germs cause. In other words, he thought that the liquids in which the bacteria were grown in the laboratory might be used after the bacteria were killed or removed to protect animals from the disease caused by these specific bacteria. The experiments made at that time with the fowl-cholera microbe failed to confirm this theory, but later experiments with the hog-cholera bacillus gave unmistakable proof of its correctness. These results were first published in 1886,[1] and additional evidence was published the following year.[2]

IMPORTANT RESULTS OF THE STUDY OF IMMUNITY.

The demonstration of this new principle in pathology led to numerous efforts to apply it in practice and to renewed activity in the study of the general subject of immunity by the various laboratories of the world. The result has been the extraordinary development of knowledge of the toxins and antitoxins, and the application of these substances to the prevention and cure of disease. Koch took up the study of the tubercle bacillus from this point of view and experimented with the culture media in which it had been grown. The high hopes which were raised all over the world by the announcement of the discovery by him of a substance which would act as a specific for tuberculosis are well remembered, as is also the keen disappointment which followed the practical tests of the new remedy.

Koch observed that the administration of tuberculin caused an elevation of temperature in persons affected with tuberculosis, and he found it an extremely valuable means of recognizing the disease in the early stages before bacilli appeared in the sputum and before any information could be obtained by physical examination.

[1] Second Annual Report, Bureau of Animal Industry, p. 219.

[2] Third Annual Report, Bureau of Animal Industry, p. 50.

This discovery at once became of interest to veterinarians, who had long been embarrassed by the great difficulty of detecting tuberculosis in cattle. The diagnosis of this disease was often uncertain, even when the lungs were badly affected; but when it was confined to the glands of the chest or to the organs of the abdominal cavity its presence in the great majority of cases was not even suspected during the life of the animal. The value of tuberculin for this purpose was tested during the years 1890 and 1891 by Guttman, Roeckl and Schütz, Bang and Salomonsen, Lydin, Jöhne and Siedamgrotzky, Nocard, and many others. It was at once recognized as a most remarkable and accurate method of detecting tuberculosis even in the early stages and when the disease had yet made but little progress.

TUBERCULIN TEST IN PRACTICE.

The tuberculin test came into existence through the most careful and thorough scientific experimentation. In practice it is applied by first taking the temperature of the animal to be tested, at intervals of about two hours, a sufficient number of times to establish the normal temperature of the body under the ordinary conditions of life. The proper dose of tuberculin is then injected under the skin with a hypodermic syringe. The injection is generally made late in the evening, and the temperature is taken every two hours the following day, beginning early in the morning and continuing until late in the evening, if the fullest information is desired. From average temperatures calculated by de Schweinitz in 1896 of about 1,600 tests of tuberculous cows, it appears that in general the rise of temperature begins from five and one-half to six hours after the tuberculin is injected, reaches its greatest height from the sixteenth to the twentieth hours, and then gradually declines, reaching the normal again by the twenty-eighth hour.

A certain number of errors in diagnosis were, however, recorded in these early experiments which raised some question as to whether tuberculin was sufficiently accurate for universal adoption in the examination of cattle for this disease. The failures were of two kinds. A small percentage of the animals which showed an elevation of temperature were apparently free from signs of tuberculosis when examined after slaughter, and about an equal proportion failed to react, which upon slaughter proved to be diseased. Subsequent investigation showed, however, that the supposed errors might be largely reduced, first, by not recognizing any elevation of temperature less than 2° F. as a reaction; second, by requiring that the temperature should go to about 104° F.; third, by taking into account the tuberculin curve of the chart; fourth, by giving a sufficient dose of tuberculin; and, fifth, by making a more careful search through the carcass after slaughter for signs of the disease. The diseased animals which

failed to react were found to be either in an advanced stage of the disease (and this was easily recognizable by other means), or the disease had become arrested, and for the time being did not affect the system of the animal.

EFFICACY OF THE TUBERCULIN TEST.

In 1898, Bang, of Copenhagen, one of the highest European authorities, in his paper presented to the Congress for the Study of Human and Animal Tuberculosis, at Paris, said:

Numerous tests made in almost every civilized country have demonstrated that in the majority of cases tuberculin is an excellent means for diagnosing the existence or the nonexistence of the disease, but giving us no positive information as to the extent to which the disease has progressed. When tuberculin produces a typical reaction we may be almost sure that there exists in the body of the animal a tubercular process. The cases in which a careful examiner has not succeeded in finding it are very rare; and I am led to believe that when, notwithstanding all the pains taken, it has escaped discovery, the reason is that it is located in a portion of the body that is particularly inaccessible. Nevertheless, it is not to be denied that a fever, entirely accidental and of short duration, may in some rare cases have simulated a reaction. However this may be, the error committed in wrongly condemning an occasional animal for tuberculosis is of no practical consequence.

A worse aspect of the case is that there are some diseased animals in which tuberculin fails to discover the existence of tuberculosis. In most of these, no doubt, the deposits are old, insignificant, and generally calcified, or they are cases where the disease is arrested and perhaps in process of recovery, and which are possibly incapable of disseminating the contagion. But it is known that there are cases, not altogether rare, where tuberculin fails to cause a reaction in a highly tuberculous animal, and consequently one in which the disease exists in an extremely contagious form. For this reason a clinical examination should always be made of an animal which does not give a reaction, but which shows symptoms indicating that notwithstanding the test it may suffer from tuberculosis.

Nocard, of Paris, wrote, also, in 1898, as follows:

The degree of certainty of the indications furnished may be stated in precise terms. *The observation of a clear reaction to tuberculin is unequivocal; the animal is tuberculous.* The pretended errors imputed to the method are explained by the extreme sensitiveness of the reagent, which is capable of detecting the smallest lesion. It often requires prolonged and minute researches in the depths of all the tissues to discover the few miliary centers, the presence of which has been revealed. The reaction is absolutely specific. In those cases where it is observed, with animals which show lesions of another disease (actinomycosis, hydatid disease, verminous bronchitis, distomatosis), it may be affirmed that there exists, in addition to these conspicuous changes, a tuberculous center which alone has provoked the reaction.

The failure to react does not necessarily imply absence of tuberculosis. Such failures of tuberculin are very exceptional. They are seen most frequently with animals affected with tuberculosis in a very advanced stage and made evident by plain external signs. Sometimes, also, there are found at the post-mortem examination of animals which have not reacted small fibrous or calcified lesions in such a condition that one is tempted to believe them cured. Whether sterile or not, these lesions have no tendency to increase and they are not very dangerous from the point of view of contagion.[1]

[1] Les Maladies Microbiennes des Animaux, p. 606.

These opinions of two eminent authorities, living in different countries, after long experience of their own and after studying the results of the many tests made in different parts of the world, should have great weight; they coincide throughout and are essentially the same. A similar conclusion was reached from experiments made in the Bureau of Animal Industry in 1893. In the extensively diseased herd of the Washington Soldiers' Home, 60 animals were tested, all of which were afterwards slaughtered and carefully examined. Of the 60 animals tested, 49 reacted and 11 failed to react. Tuberculous lesions were found in 48 of the animals which reacted. Five animals which did not react were also found to be diseased. One of these had a high temperature (103.6° F.) the day before the test, and this animal had extensive tuberculosis. The disease had been recognized in this animal from external appearance, and it had been isolated from the herd for from fifteen to eighteen months. Three other animals which did not react were in all probability stationary cases of disease; the nodules were small and largely calcareous. In the remaining animal which failed to react, the lesions were also small and apparently confined to the glands.

In 1897 Voges compiled statistics of tuberculin tests, the accuracy of which had been determined by post-mortem examination. Of 7,327 animals tested, it appeared that errors had been made with 204, or 2.78 per cent.[1] In the work of the Pennsylvania Live Stock Sanitary Board, post-mortem examinations were made on about 4,400 reacting cattle, and the disease was found in all but 8 of those which had given characteristic reactions.

The results of a much larger number of tests might be compiled at this time, but they would not materially change the average of those already mentioned. It is plain that tuberculin is a remarkably accurate test of tuberculosis; that the animals which react may be safely considered as tuberculous; and that when a careful clinical examination is practiced in addition to the test, there are few animals in a dangerous condition which escape detection.

IS TUBERCULIN INFALLIBLE?

The first questions asked by those who oppose the adoption of the tuberculin test are, Is this test infallible? and, If it is not infallible, why should it be forced upon the cattle owners of the country?

In answer to these questions it may be said that tuberculin is not absolutely infallible, and yet it is by far the best method of diagnosing tuberculosis that has been discovered. It is much better than any test known for pleuropneumonia when that disease was eradicated.

[1] Voges. Der Kampf gegen die Tuberkulose des Rindviehs. Jena, 1897, pp. 14 and 15.

Practically all the animals which react are affected with tuberculosis, and should be separated from the herd, not only in the interest of the public, but in the interest of the owner of the herd. The best authorities admit, after studying many thousands of tests, that there are few if any mistakes made in condemning cattle which show a typical tuberculin reaction. The errors are principally in the other direction, that is, some tuberculous animals are not discovered by the tuberculin test; but as the most dangerous of these may be picked out by ordinary clinical examination, this fault of tuberculin is not so serious as it at first sight appears. This being the case, it should not be necessary to force the tuberculin test upon cattle owners. They should be anxious to adopt it in their own interests and for the protection of their patrons. There is to-day no greater danger to the cattle and swine industries than that which confronts them in the form of tuberculosis, a disease already widespread and rapidly extending. Without the use of tuberculin it would be impossible to control this disease, and the farmer and stock raiser would be at its mercy. With tuberculin its control is not a difficult matter, and badly affected herds may be converted into healthy herds in a few years, and without very serious loss or hardship. Tuberculin is, therefore, a great boon to the farmer—one of the most beneficial scientific discoveries of modern times.

Many cattle owners have been prejudiced against the tuberculin test by incorrect or greatly exaggerated statements as to damage caused to cattle by the injection of tuberculin. Some of these statements have been based upon attacks of illness in no way connected with the tuberculin test. It was, for example, widely published that a valuable Shorthorn bull was seriously damaged in the Garfield quarantine station by being tested for tuberculosis. The facts are that this bull was purchased in Great Britain by a Canadian dealer for a breeder in the United States at a very high price—a price which should have insured an animal in the best condition. The animal arrived at the quarantine station without appetite and suffering alternately from diarrhea and constipation. Either it had been unduly forced and overfed or the effects of the sea voyage had been unusually severe. However this might be, it did not recover its appetite or condition while at the quarantine station. After it had been in quarantine fourteen days it was tested. At this time it was suffering from constipation. It did not show any unusual symptoms after the injection of the tuberculin, nor did it appear to suffer from it. Two or three days after the tuberculin was injected, and when the effects of the drug could no longer have existed, the attendant gave a purgative to counteract the constipation. This medicine did not have the desired effect, but caused nausea, and evidently frightened the man in charge, who reported the facts to Dr. George W. Pope, superintendent of the station. Dr. Pope did not

consider the bull to be in a serious condition, and gave a simple remedy, which restored the animal to its usual condition of health. The importer and the attendant both appeared to attribute the lack of condition and delicate health of this high-priced animal to the tuberculin test rather than to the real cause.

CONCLUSIONS OF AUTHORITIES ON TUBERCULIN TESTS.

Many persons have in recent years studied the effects of tuberculin as they have been revealed by tests covering vast numbers of animals, and in the present uncertain condition of the public mind in this country on the subject the writer deems it advisable to quote the conclusions of some of the best authorities.

Nocard and Leclainche say:

Direct experiments and observations collected by thousands show that the tuberculin injections have no unfavorable effect. With healthy animals the system is indifferent to the inoculation; with tuberculous animals it causes only slight changes which are not at all serious.[1]

Bang has written as follows on this question:[2]

We will now consider the following question, a very important one in the application of tuberculin, viz: Can the reaction produce a worse condition in tuberculous animals than before existed? Hess emphatically states that it can, and on this account he earnestly warns against its application.[3] My attention has been directed to this question from the beginning. In my first publication on tuberculin injection[4] I reported two cases in which acute miliary tuberculosis was proved in two high-grade tuberculous cows several weeks after the tuberculin injection. I then stated my suspicion that perhaps the tuberculin injection had some connection with this, just as is often supposed to be the case in human practice. With my present very large amount of material for observation at hand I may express the following opinion: Such an acute development of tuberculosis as a result of tuberculin injection is to be feared only exceptionally, and then in cases of advanced tuberculosis. *It must not be forgotten that acute miliary tuberculosis by no means rarely accompanies an advanced tuberculosis of long standing.* It is, therefore, impossible to offer strict proof of the causal connection with the injection, and only oft-repeated observation could make this probable.[5] In support of my view I offer the following: In the course of the last three years I have made careful post-mortem examinations of 83 tuberculous animals which have been removed from my experiment farm, Thurebylille. Among these were 18 (or strictly speaking 23) high-grade tuberculous animals. I have been able to prove miliary tuberculosis in only 4 of these. Among the others, which showed less developed tuberculosis, I have never found miliary tuberculosis, and with very many I have never found any sign of a more rapid development of the process. On the contrary, it has been proved that the disease was restricted locally, often for years, in spite of yearly repeated injections. Dissections were made at very different periods after the injections—in 17 cases from four to twelve days after the last test. In all of these cases earlier tests had been made months or years

[1] Les Maladies Microbiennes des Animaux, p. 606.

[2] Bulletin 41, Hatch (Mass.) Experiment Station, 1896, pp. 14–16. Translated from Deutschen Zeitschrift für Thiermedicin und Vergleichende Pathologie, Band XXII.

[3] Landwirthschaftl. Jahrbuch, 1894, VII, p. 404.

[4] Berliner Thieraerztliche Wochenschrift, 1891. Tidskrift für Veterinaerer, 1891.

[5] This view I fully indorse, and do so supported by experience gathered from material forwarded me twice weekly from the Dresden slaughterhouse.—*Jöhne.*

before. In 28 cases the injection took place from nineteen days to two months before the butchering; in 3 of these cases earlier injections had been made. In 38 cases from two and one-half months to one year intervened between the last injection and the dissection. Dissection gives the best explanation of this question, but a clinical observation, continued for years, of a herd tested with tuberculin can render very essential aid. If Hess's opinion is correct, it is to be assumed that tuberculosis must take an unusually vicious course in such herds, but this I have been unable to prove. At Thurebylille there has existed for three years a reacting division, consisting originally of 131 head and now of 69. Although these animals are yearly tested, and although most of them react every year, the division certainly appears to be made up of healthy animals, and the farm inspector has expressed the decided opinion that the tuberculosis in this division is no more developed than at the beginning of the experiment. The testimony of many owners of large herds of cattle which have long ago been injected is to the same effect. I will adduce statements from several. A farm tenant whose cattle were injected twenty months previously, when 82 per cent of the grown animals reacted, wrote me recently as follows: "Only 2 cows from the division of 100 head had been sold as decidedly tuberculous. The majority appeared afterwards, just as before, entirely healthy. The fat animals which had been slaughtered had been pronounced healthy by the butchers." Another farm tenant with a herd injected in 1894 had not been obliged to remove a single animal from the tuberculous division, numbering 70 head. A large farm owner in Jutland stated in September that he had traced no undesirable result from the injection. His herd of 350 had been injected in February and about 75 per cent reacted. Similar answers have been given by other owners and veterinarians.

A veterinarian who had injected 600 animals, among them a herd of a large farm eighteen months previously, expressed the belief that the injection had produced in no single case an unusually rapid or vicious course of tuberculosis. In spite of a demand made months ago, I have received thus far no report from any veterinarian of an undesirable result.

On a large farm, on which before the injection tuberculosis had appeared in a vicious form, the owner had the impression that the severe cases had afterwards become more numerous. He had, however, not suffered severe losses, and eight months later the large reacting division by no means made a bad impression. Finally, it is to be noticed that tuberculin has been employed on a large scale in Denmark for years, and still the demand from farmers constantly increases. This could certainly not be the case if the injections were generally followed by bad results.

Paige said, after the tests of the herd of the Massachusetts Agricultural College, "that its use is not followed by any ill effects of a serious or permanent nature."[1]

Lamson, of the New Hampshire College Agricultural Experiment Station, said: "There is abundant testimony that its use is not in any way injurious to a healthy animal."[2]

Conn, who made a special study of the present attitude of European science towards tuberculosis in cattle, reached the following conclusions:[3]

It has been, from the first, thought by some that the use of tuberculin produces a direct injury upon the inoculated animals. This, however, is undoubtedly a mistake, and there is no longer any belief anywhere on the part of scientists that the injury

[1] Bul. No. 27, 1894, p. 22.
[2] Bul. No. 78, 1900, p. 169.
[3] Eleventh Annual Report, Storrs (Conn.) Agl. Exp. Station, 1898, p. 46.

thus produced is worthy of note. In the first place, the idea that it may produce the disease in a perfectly healthy animal by the inoculation is absolutely fallacious. The tuberculin does not contain the tubercle bacillus, and it is absolutely certain that it is impossible to produce a case of tuberculosis in an animal unless the tubercle bacilli are present. The use of tuberculin, therefore, certainly can never produce the disease in the inoculated animal.

It has been more widely believed, however, that the inoculation of an animal with this materal has a tendency to stimulate an incipient case of tuberculosis. It has been thought that an animal with a very slight case of the disease may, after inoculation, show a very rapid extension of this disease and be speedily brought to a condition where it is beyond any use. The reasons given for this have been the apparent activity of the tuberculosis infection in animals that have been slaughtered shortly after inoculation. This has been claimed, not only by agriculturists who have not understood the subject well, but also by veterinarians and bacteriologists. But here, too, we must recognize that the claim has been disproved, and that there is now a practical unanimity of opinion on the part of all who are best calculated to judge, that such an injurious effect does not occur. Even those who have been most pronounced in the claim that there is injury thus resulting from tuberculin have, little by little, modified their claim, until at the present time they say either that the injury which they formerly claimed does not occur, or that the stimulus of the disease is so slight that it should be absolutely neglected, in view of the great value which may arise from the use of tuberculin. Apart from two or three who hold this very moderate opinion, all bacteriologists and veterinarians unite in agreeing that there is no evidence for believing that any injury results. In Denmark, especially, many hundreds of thousands of animals have been inoculated, and the veterinarians say there is absolutely no reason in all their experience for believing that the tuberculin inoculation is followed by any injurious results.

In 1898 tuberculosis was found in the large Shorthorn herd belonging to W. C. Edwards, of Canada, who with commendable promptness and public spirit had his animals tested, and at once proceeded to separate the diseased from the healthy animals. These were all finely bred animals, and the very class which we have been told are most susceptible to the injurious effects of tuberculin. After using this test regularly for two years, Mr. Edwards wrote as follows:

> I have seen nothing to lead me to believe that the tuberculin test had any injurious influence on the course of the disease. It is by no means our opinion that the disease has been stimulated or aggravated by the application of the tuberculin test. All animals that we have tested two or three times continue as hale and hearty as they were previously, and not one animal in our herds has broken down or failed in any way since we began testing.[1]

Mr. Edwards, in December, 1901, verbally stated to the writer that his views as to the harmlessness of tuberculin remained unchanged, and that he had not seen the least ill effect with any of his cattle from its use.

EXPERIENCE OF STATE AUTHORITIES IN SUPPRESSION OF TUBERCULOSIS.

In order to learn the experience and views of the various State authorities engaged in the suppression of tuberculosis by means of the

[1] Tests and Treatment of Tuberculous Cattle, Ottawa, 1900, p. 11.

tuberculin test, inquiries were made of them as to whether any injurious effects had resulted from the use of tuberculin in their work. The replies are summarized as follows:

C. J. Bell, secretary of the Board of Agriculture and Cattle Commission, Vermont: My experience the last four years as one of the cattle commissioners in Vermont leads me to believe there is no injury to healthy cattle by the use of the tuberculin test in sections of the State that are troubled with abortion, and that is in nearly all parts. This trouble is just as likely to occur in sections where herds have never been tested with tuberculin as elsewhere. Since January 1, 1895, some 85,000 or 90,000 head of cattle have been tested in Vermont, and the cattle commissioners serving before me will stand by the statement that up to date we have no reason to believe any healthy cow has been injured by the use of tuberculin. But when cattle are diseased with tuberculosis its use is sometimes injurious.

Dr. Austin Peters, chairman of the Board of Cattle Commissioners, Massachusetts: I do not think tuberculin does any harm to cattle if properly used. I think that cows just on the verge of calving are perhaps not fit subjects for the test, and also think perhaps harm may have been done by the use of syringes that were not properly cleansed, or by tuberculin that had been opened and allowed to stand, or something of that sort; but, ordinarily, I do not think the tuberculin test does any harm to healthy cattle.

In regard to its causing abortion, I suppose that all abortions among cows that have been tested with tuberculin are blamed to the use of this agent; but I doubt if any more abortions occur now than did before it was used. Prior to the use of tuberculin, people had to try and blame something else. I remember an instance, when we had a great deal of infectious abortion in Massachusetts, where a farmer, in Worcester County, had 15 out of 16 cows abort during one winter. If this had been after the discovery of tuberculin, and that herd had been tested with tuberculin the previous autumn, the abortions, of course, would all have been blamed to tuberculin. I think the tuberculin test is used by some farmers and breeders as a scapegoat for all sorts of misfortunes, in many instances where the fault is due to their own lack of care. Many herds of cattle, owned by various farmers, have had tuberculosis introduced among them as the result of buying a pure-bred bull from some breeder; and many of the breeders of pure-bred stock have been breeding tuberculosis as carefully as they have cattle for a great many years.

Since I have been a member of the board (December, 1896) a large number of animals have been tested with tuberculin. In 1896, 8,969 head of neat stock were tested, of which 4,694 were condemned as having tuberculosis. In 1897, 9,991 head were tested and 5,435 were condemned and paid for as tuberculous. In 1898 the legislature thought the commission had been spending too much money, and the board was given a smaller appropriation, and did not do much work, but animals brought into the State from without its limits were still required to be tested with tuberculin, and during the year nearly 27,000 head of cattle for dairy or breeding purposes were brought into Massachusetts. In 1899 about 25,000 head of cattle were brought in from without the State, which were required to be tested with tuberculin, and a few herds were tested at the request of the owners, who wished to eradicate the disease. In the latter way 565 animals were tested, of which 480 were released. During 1900, 21,000 have been brought in from without the State, upon which a tuberculin test has been required, and a few herds have been tested at the request of the owners—291 animals, of which 227 were released. We have had no complaints from any of the owners of injuries to their cattle as a result of the tuberculin test.

Franklin Dye, secretary of Commission on Tuberculosis in Animals, New Jersey: We have the records in our office of about 10,000 tests, in round figures, made during the last year (1900), and have been unable as yet to trace satisfactorily a single

instance where abortion has been produced by using the tuberculin test. There are a few dealers who claim that it is injurious to cattle under some conditions, but this comes from a class who do not like the law, and are opposed to it because it is attended with a little extra work and some expense; but no respectable dealer who is willing to comply with the law, and believes at the same time that the protection it affords is beneficial, makes the least objection. As there is no doubt as to the prevalence of tuberculosis to a very large extent in European countries whence cattle are shipped into our country, we regard the precaution not only good, but an absolute necessity.

Dr. Leonard Pearson, State veterinarian, Pennsylvania: I have made, and have had made under my supervision, about 100,000 tuberculin tests, and I have known of but one instance wherein it was even suspected that tuberculin had the effect of causing abortion. This case is one that occurred recently, wherein two cows aborted in a herd of about 75 members on the day following the test. I do not, however, believe that the test had anything to do with the abortion in this case, and am inclined to ascribe the accident that occurred to causes disassociated with the use of tuberculin. I think I can be very positive on this point, because if tuberculin had any influence whatever in producing abortion it would certainly be apparent in more than two cows out of nearly 100,000.

In the last report of the Pennsylvania department of agriculture letters are given from 446 owners of tested herds. These letters give general information in regard to the results of the inspections that have been made, and also report the condition of the cows following the test. Not one of these 446 herd owners mentions that abortion has occurred, and generally the herds are in better condition than before tuberculin was used.

The three largest owners of dairy cows in the Eastern States are the Fairfield Farm Dairy at Caldwell, N. J., Briarcliff Farms in Westchester County, N. Y., and the Walker-Gordon Laboratory Company, with branches in all of the principal cities. All of the cows added to the herds on these farms are tested with tuberculin, and I have personal knowledge that the herds have been in far better condition since this practice was inaugurated than before. Many of the cows that are purchased for these farms are heavy with calf, and are tested in this condition. Instead of having any influence in the direction of causing abortion this accident occurs less frequently than before the test was used. The owner of one of these herds has told me that the tuberculin test is worth $2,500 a year to him in keeping his cows in good condition. That is, since he has been using the test none of his cows run down in condition from tuberculosis and have to be sold for a nominal price; on the contrary, they remain in good condition and are sold fat.

In the report of the Pennsylvania department of agriculture for 1898 it was stated that there was no reason whatever to believe that tuberculin ever injured cows, and no reports of suspected injury had been received. Such reports have been solicited, and none have come to my attention with the exception of the one mentioned at the beginning of this letter. It is my experience that the tuberculin test is in greatest demand in those parts of Pennsylvania where it has been used most and is best understood. The use of tuberculin is rapidly increasing in this State. Our laboratory sent out more than 60,000 testing doses of tuberculin last year.

In conclusion, I will say, unreservedly, that I know of no evidence and have no reason to believe that tuberculin has any influence whatever in causing abortion.

C. P. Johnson, secretary State Board of Live Stock Commissioners, Illinois: During the year ending November 1, 1897, this board tested 851 domestic cattle; during the year ending November 1, 1898, 229; during the year ending November 1, 1899, 3,655, and during the year ending November 1, 1900, 2,556—a total of 7,291. There is among all these tests not one authentic case of abortion due to the tuberculin test, and I know of no alleged cases that have any foundation in fact.

From January 1, 1899, to August 7, 1900, there were tested at Union Stock Yards, Chicago, for shipment to points in this State, in round numbers, 7,000 head. The cow brokers, shippers, and dealers, who have used every possible argument that could be trumped up in opposition to the enforcement of these regulations, have maintained that among the imported cattle tested there were frequent cases of abortion which they allege are chargeable to the tuberculin test; but this board is of opinion that the tuberculin test is not responsible for any of these cases of abortion. It stands upon the record of observations made during its four and more years of experience. Among those dairymen in this State who have had their cattle tested annually for a number of years there has never been any complaint whatever from abortion. I am of opinion that an authentic case can not be produced.

Dr. M. H. Reynolds, veterinarian to State Board of Health, Minnesota: Two thousand two hundred and ninety-four cattle have been tested by me personally or under my immediate supervision, and it has been my duty to look over thousands of records in the course of our State work during the past three years. While doing this work nothing has ever occurred which would make it reasonably appear that any of these cows had lost their calves under circumstances that could fairly lead to the conclusion that this trouble was attributable to the tuberculin test.

I think the best evidence bearing on this point that has occurred in the course of my experience with tuberculin is contained in a table published by the Minnesota experiment station (Bulletin No. 51, pages 367–371). The station herd at the time of this test was composed mainly of nervous, sensitive, high-type dairy cows. Anyone at all familiar with this class of cattle ought to understand readily that the herd could not have given practically the same total milk and total butter fat during the week of test as during the week preceding test, if the agent used or any circumstances connected with the test had even moderately disturbed the cows. We have never had an abortion occur in the station herd since the test was introduced here that could be in any way attributed to the tuberculin test, although the test is conducted without any regard to the condition of pregnancy. The only point taken especially into consideration is that the test is probably not quite so reliable during the last week or so of pregnancy.

Dr. J. I. Gibson, State veterinary surgeon, Iowa: There have been tested under my supervision in Iowa upward of 4,000 cows, in all stages of pregnancy, and it has not come to my knowledge that a single cow has aborted apparently as a result of the test applied, which fact warrants me in saying that from my personal knowledge and experience with the test it does not produce abortion, and further, that it is not detrimental to nontuberculous animals.

In my opinion there is absolutely no reason for complaint of injurious effects when the cattle are properly and carefully tested. A rough set of attendants can abuse a herd of cattle a great deal during a test, and when they do the owners charge the ill effects to the action of the tuburculin, which is not in any way responsible, in my judgment.

GENERAL CONCLUSIONS REGARDING THE TUBERCULIN TEST.

Those who have had most experience with tuberculin have, consequently, failed to observe any injurious effects following its use upon healthy cattle. With tuberculous cattle it produces a fever of short duration, and in the great majority of cases all derangement of the system which it causes disappears within forty-eight hours after the tuberculin is administered. There appear to have been a very few cases in which the disease was aggravated, and a greater number in which it was benefited by the injection of tuberculin. The cases of

abortion following the tuberculin test have not been numerous, even when cows were tested within a few weeks of the normal time of calving. The few cases of abortion which have occurred may be explained by the fact that abortion in cattle is a very common occurrence, and that it would inevitably happen sometimes after the tuberculin test as a mere coincidence, and without any relation between the test and the loss of the calf. The cases of abortion which have been cited appear to be no more numerous than might be expected to have occurred among the same number of cattle within the same period if the test had not been applied.

From the investigations and observations that have been mentioned, it may be safely concluded—

(1) That the tuberculin test is a wonderfully accurate method of determining if an animal is affected with tuberculosis.

(2) That by the use of tuberculin the animals diseased with tuberculosis may be detected and removed from the herd, thereby eradicating the disease.

(3) That tuberculin has no injurious effect upon healthy cattle.

(4) That the comparatively small number of cattle which have aborted, suffered in health, or fallen off in condition after the tuberculin test were either diseased before the test was made or were affected by some cause other than the tuberculin.

COMMERCIAL APPLE ORCHARDING.

By G. B. Brackett,
Pomologist, Bureau of Plant Industry.

INTRODUCTION.

The apple is "king of fruits" wherever it may be successfully grown. It is found in almost every country that has a temperate climate. No other fruit succeeds over so wide a range of territory and under such diversified climatic conditions, and no other fruit brings so sure a return to the grower in proportion to time and money expended upon its production. With proper selection of varieties, location of soil, and subsequent intelligent management, there can be but little risk in planting the apple, which is now no longer a luxury but a staple article of food.

There is scarcely any limit to the choice varieties to select from, beginning with the early ripening Yellow Transparent, Early Harvest, Red June, Early Joe, Maiden Blush, etc., through the list of fall, early winter, and late keeping varieties, including the luscious Pearmain, Rambo, Dyer, Grimes, Jonathan, Spitzenbergs, Yellow Newtown, etc. Indeed, so wide is the range of season of the apple that it is the only fruit of the temperate climates that may be obtained and enjoyed in its natural state throughout the year. Its period of usefulness is being extended through modern methods of storage, and with rapidly increasing facilities for its transportation, its commercial value is greatly enhanced.

From a hygienic standpoint the apple has but few rivals among cultivated fruits. Its mild and pleasant acid is a panacea for many of the ills that the human race is heir to. What fruit can be more pleasant to the palate or more beautiful to the eye than the rich ripe Golden Pippin when plucked fresh from the tree, or what more luscious and healthful when cooked? Who does not remember with extreme delight the delicious baked apple served with sugar and cream or the apple dumpling or apple pie "that mother used to make?" What is more indelibly fixed in our memories and what more pleasing to recall than the happy days of boyhood when clambering into apple trees and filling pockets with luscious ripe fruit from bending boughs?

The apple has not, however, until recent years been grown in commercial quantities of magnitude. Formerly small family orchards of

50 or 100 trees were the average planting. The apple was then grown more for family use than for commercial purposes. But the vast progress and development of apple culture in area covered, the quantity and quality of product, together with the increased demand for home use and exportation, now places this industry in the front rank of commercial resources. Instead of orchards of 100 trees we now find orchards of hundreds and even thousands of acres each, and capital in large amounts is being invested annually, not only for home markets, but for extensive export to foreign countries in fresh and cured forms. The magnitude of the crop has become such that houses and storerooms, refrigerators, evaporators, and places for expressing the juice have been constructed at all points in fruit regions required for economic disposition of crops.

SECTIONS ADAPTED TO APPLE GROWING.

Although the apple may be grown over a very wide range of country more or less suited to its cultivation, there are certain districts especially adapted to its successful growth. For instance, the elevated portion of southern Missouri and northern Arkansas, known as the Ozark region, and the elevated portions of North Carolina and Virginia, where similar conditions exist, are striking examples. The New England, Middle, and some of the Western States are especially favorable for producing fine crops of this fruit of highest quality, and certain sections of Idaho, Colorado, Oregon, and Washington are rapidly coming to the front in successful orcharding. Indeed, there is not a State in the Union in which the apple, in some of its varieties, may not be successfully grown. In addition to soil and climate the proximity to transportation by railroads and water routes is an important consideration in locating an orchard for commercial purposes.

SITE AND SOILS SUITABLE FOR APPLE GROWING.

In the selection of a site for apple growing, the injurious effects of exposure to intense heat and cold should be guarded against as far as practicable. This may in part be accomplished by selecting a northern or eastern slope which is quite safe against the direct rays of the sun. The site, if possible, should be elevated above its immediate surroundings, so as to give free air drainage and also ward off late spring frosts, which often kill the fruit germs in blooming time.

The apple may be grown on almost any soil, but the best results are obtained on soils from which native forests have been cleared. Here the physical conditions are such as to afford both ample surface drainage and subdrainage, and the soils are well supplied with the various kinds of plant food essential for a healthy wood growth and finely developed, well-matured fruit crop. Fruit from trees growing on such locations possess the richest quality and highest coloring. But other

locations may be successfully used if the soils receive the necessary preparation before planting and careful cultivation afterwards.

Clay soils require more labor in their preparation, and often need manuring and frequent cultivation and subsoiling. The soil should be frequently stirred during the summer months, and especially during continued droughts. Certain varieties of apples, like Rome Beauty, succeed best on sandy soils, but such lands require fertilizers to keep the trees in vigorous growth. The wood growth on loamy soils will be strong and vigorous, but may not be sufficiently mature to withstand the freezing of rigorous winters. Clay lands do not produce such vigorous growth, and trees on such land are not so liable to winter-kill. With a free subsoil underlying it a loamy clay soil will probably yield the best results, especially if it be well prepared by thorough cultivation and subsoiling before planting. Nearly all lands for orchards should have both thorough surface drainage and subdrainage. No orchard will endure for a great length of time with stagnant water either upon the surface or within the soil. All surface water from excessive rainfall or other causes should be promptly removed by either surface drainage or subdrainage. If the natural formation of the land does not afford such ready drainage it must be provided artificially. Surface ditches or furrows between the rows of trees may afford temporary drainage, but they are undesirable, for the reason that an orchard thus drained will be difficult to get over in order to give necessary care and also to gather the fruit. Subdrainage is preferable, and is much more thorough when supplied with well-laid tile. A breaking up of subsoil will afford temporary drainage in a clay soil, but in a few years the soil will again become compacted, when restirring will be difficult on account of the roots of trees. In all cases the planter should be the judge of the special requirements of his soil and location as to drainage.

PREPARATION OF SOIL FOR PLANTING APPLE TREES.

The autumn months are generally regarded as the best time to prepare all lands that are designed for apple orchards. The plowing should be as deep as possible, and if the subsoil is stiff clay it should be subsoiled by running a subsoil plow in the furrow made by the turning plow. A good plan is to back-furrow the land so as to leave the dead furrow where the rows of trees are to stand, thus leaving it in a condition for the ameliorating effect of frost. It would be beneficial to break up the bottom of this dead furrow by running the subsoil plow through it two or three times, giving it a good stirring. This method will afford deeper tilth under the trees and allow surplus water to pass off if the orchard is laid off with this object in view. If the autumn preparation is thoroughly done there will not be any need of more than a surface stirring of the soil in the spring.

If the land selected is not in a fertile state at time of plowing it should be enriched with thoroughly rotted stable manure, spread broadcast over the land before it is plowed. Manure is sometimes successfully used by applying it to the land in the fall as a surface dressing, allowing it to remain until spring, when it is thoroughly worked into the soil with a plow or heavy two-horse cultivator. Unleached wood ashes spread about the trees after they are planted afford an excellent fertilizer.

VARIETIES OF APPLES VALUABLE FOR COMMERCIAL PURPOSES.

In considering the apple as a commercial article it must be studied in all its features in reference to its fitness both in tree and fruit. Most of the varieties now under cultivation are in no wise commercial sorts.

The main point in the selection of a variety should be the determination of its valuable qualities as an article of commerce. This can best be determined by an inquiry in the markets as to what are the sorts that command highest prices and find readiest sale. Such an investigation will show that a fairly large, highly colored fruit invariably attracts the eye of the purchaser. A clear, bright red apple will be preferred by many to any other color, but to the commercial orchardist this is not the only desirable character, for some varieties of trees bearing bright red apples are not profitably fruitful, nor are the apples good keepers and shippers. The main points to be considered in the selection of varieties for a commercial apple orchard are medium to large size, attractive in color, good in quality, fair to late keeping, firm enough to handle and ship well, and adaptation to locality. The latter is especially important and can not be too highly emphasized, for a variety may have all the necessary qualifications for a perfect apple, yet if the tree is not suited to its environment it will be a failure for commercial purposes.

One of the most common mistakes made by the commercial apple orchardists is in planting too many varieties. Having obtained a list of varieties that have been found by actual experience to be adapted to the locality where the orchard is to be planted, a careful selection from this list of a few of the very best should be made; the fewer the better, provided the varieties chosen are such as will meet the above-mentioned requirement in all points.

Out of a list of ten or fifteen varieties there must, of course, be a few superior to the others in desirable qualities. If so, why plant the less desirable ones? The fewer the number of varieties the less will be the trouble and expense in handling the crop.

In the list of varieties which are generally recognized as leaders in commerce the most prominent and most largely grown are such varieties as Baldwin, Ben Davis, Jonathan, Northern Spy, Rhode Island

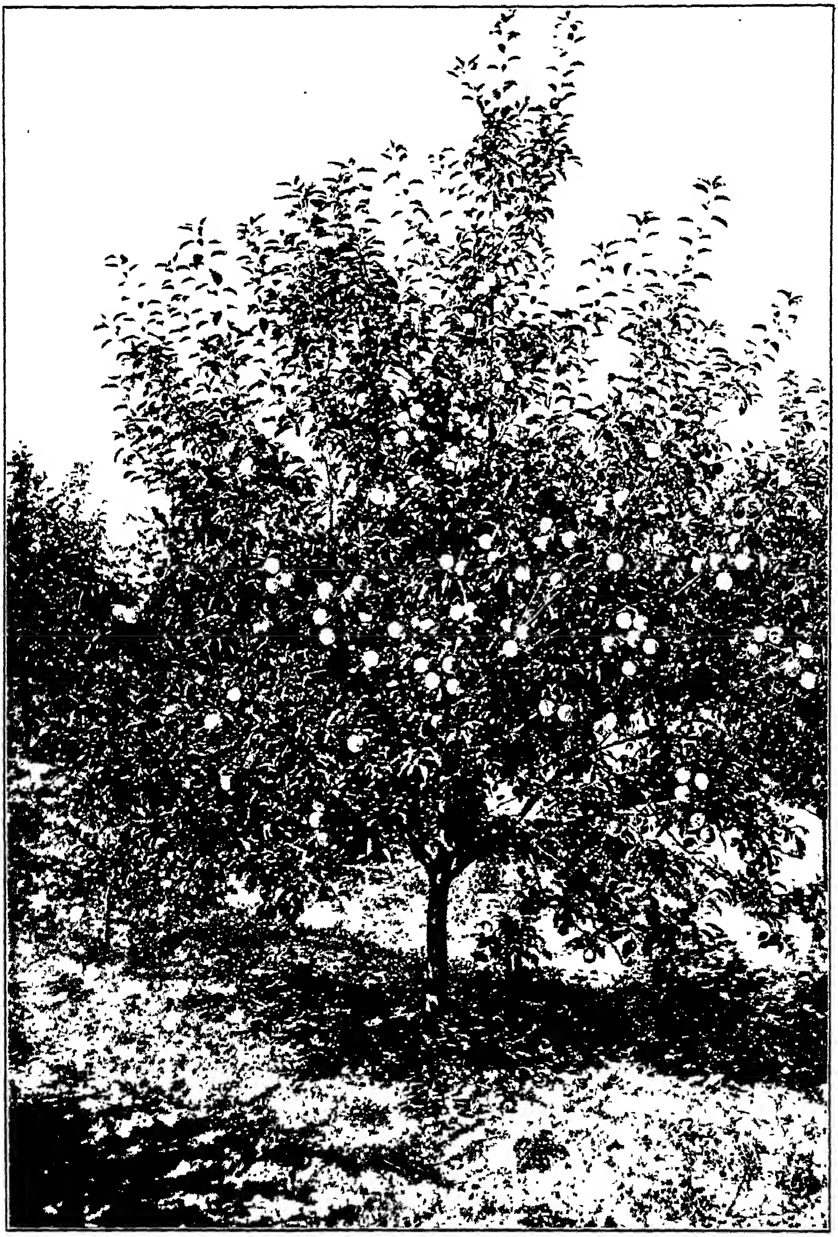
Greening, Roxbury, Tompkins King, Winesap, Yellow Newtown, York Imperial, etc., all of which are grown more or less extensively in the various sections of country to which they are adapted. The character of the trees to be planted is a matter of equal importance with the character of the fruit. The trees must be hardy, to endure the vicissitudes of the climate in which they are to grow. They should be prolific, but not inclined to overbear. Trees that bear heavy annual crops are generally short-lived, and all such should be planted in a block by themselves or as alternates in rows of those of a more enduring character. Such trees are known by orchardists as fillers. The foregoing points are of the highest importance and should be strictly regarded in the management of a commercial orchard to make it a success. It is not possible to give a list of desirable varieties which will be safe for all planters to use, as climate, character of soil, and location are very different in the various portions of the country. It does not necessarily follow because a certain variety is adapted to one locality that it will succeed equally well in all other sections. Many mistakes are made in planting orchards by not observing this law of adaptation to locality. The safest means of determining what to plant is through an investigation of varieties already fruiting that have proved a success in near-by orchards which are on a similar soil and location to the one it is proposed to plant. It is far better in commercial orcharding to plant such varieties as have been tested and found to succeed than to risk new varieties that have not been tried. In other words, no commercial orchardist can afford to experiment with untried sorts if he expects to make his enterprise a profitable one. A vigorous, well-rooted, straight trunk, evenly branched 2-year-old tree is considered the most economical kind to plant. A 1-year-old tree is preferable to any tree over 2 years old. (Pl. LXXXVII.)

As to time of planting, the best authorities differ in opinion. Some advocate late fall planting; others advocate early spring planting. It is claimed for trees set in the fall that the ground becomes firmly settled among the roots, and that all cut and lacerated roots, becoming calloused before spring opens, are prepared to push out new roots with the appearance of the first warm weather. The objections to fall planting depend upon atmospheric and soil conditions. If there is a lack of moisture in the air and soil, the fall-planted trees do not become sufficiently established to draw the necessary amount of moisture to maintain their vitality, and in regions subject to sudden extremes of low temperature the newly planted tree is liable to burst its bark and even split open the woody layers, such injury resulting in the death of the tree or in weakened vitality from which it never fully recovers. Such injuries never occur to trees planted in the spring. These are a few of the points regarding the time of planting, but they have no

bearing in localities not subject to winter freezing. In such localities there can be no objection to fall planting.

In regard to the distance apart to plant the apple tree many practical orchardists differ radically. Some advocate a closely planted orchard, as they desire to realize several crops of fruit from the land before the trees will have grown to a size sufficient to interfere with each other, when every alternate tree in each row should be cut out. To this method the objection is made that close planting will interfere with proper cultivation after the trees have come into bearing. In such systems the trees are set 20 by 20 feet apart, and when thinned out the permanent orchard will be 40 by 40 feet between trees. Others lay out the rows 30 to 32 feet apart and set the trees in the rows 15 to 16 feet apart. Such plantation will leave this permanent orchard 30 to 32 feet apart between rows. The profitableness of this close system in planting is not in the long run regarded as reliable, and many extensive planters have settled on a space of 32 feet between all trees each way, with no fillers. This distance affords ample room for cultivation with a two-horse plow or cultivator, for hauling in manure, and for removing the fruit in time of gathering. To facilitate the work of setting out trees, the site or location should be marked off in such manner as to indicate the spot for each tree. This can be quickly done by setting a stake at the end of each row on each side of the plat to be planted and then, with a two-horse plow, opening out a deep furrow from stake to stake along the proposed tree row one way. If the plan, as previously mentioned, of preparing the land in autumn by leaving the dead furrow where the row of trees is to stand, it will only now be necessary to cross check these furrows the other way at right angles, guided by stakes set at the ends at the proper distance apart for the trees. In large plantations the land should be laid out in blocks of 10 to 20 acres each for convenience in planting.

Before beginning to plant, the trees should be hauled on to the land, distributed at convenient distances, and heeled in in bunches. After the holes have been properly prepared at the intersection of the furrows by simply leveling off the bottom of the furrow sufficiently to allow the roots of the tree to be placed in natural position, the trees should be set. Three persons are necessary to do the work of setting, viz, one to prune the roots and tops and distribute along the row, one to hold the tree in place, and one to shovel the dirt in around the tree. Some planters simply line off the tree rows with stakes and set the trees by measuring off the distance along the furrow. In such instances the tree rows are straight lines only one way, and subsequent plowing and cultivation is only given to the rows in the direction in which the trees were planted for the purpose of ridging the land against the trees for surface drainage and culture. This method is recommended more especially for land that is comparatively



BEN DAVIS APPLE TREE. HILLCREST ORCHARDS, KENTVILLE, NOVA SCOTIA.

[This tree, low-branched, planted halfway between standards four years ago, produced one barrel. Photograph taken by J. Craig seven weeks before fruit was picked.]

FIG. 1.—BALDWIN APPLE ORCHARD, 25 YEARS OLD. WESTERN NEW YORK.

[Condition of orchard after first plowing in spring. Photograph by J. Craig.]

FIG. 2.—BALDWIN APPLE TREE, 40 YEARS OLD. MONROE COUNTY, N. Y.

[Record: 18 barrels of apples, 1901 (off year), selling for $3 per barrel. Photograph by J. Craig.]

level and composed mostly of clay, in which if holes were dug basins would be formed that would retain water too long after a heavy rainfall. Other planters resort to the method of carefully staking and lining the rows each way and keeping a fourth man engaged in sighting each tree into line with the stakes. In this case, the trees are set by a line stretched along the furrowed row, and the sighting is made across this row from stake to stake on opposite sides of the plat. Before setting the tree its roots should be shortened in and all bruised places pared off to sound wood, while the tops should be thinned out and cut back to offset the loss of roots occurring in transplanting. Straighten the roots to their natural position and fill in among them fine dirt, trampling firmly with the foot. The tree should be set from 2 to 4 inches deeper than when in the nursery, leaning it slightly to the south or southwest to brace it against the prevailing winds and so that the tops will afford protection to the other parts of the tree from the intense heat of the afternoon sun, which is liable to cause sun scald. An inspection of orchards in almost any portion of the country will show a large percentage of the trees leaning toward the northeast, and that their southwest sides are badly affected from sun scald, borers, and other injuries that might have been largely avoided by a little precaution at time of planting, as already indicated. After the planting is completed the open furrows between the trees may be filled up by plowing one or more furrows against the row.

CULTIVATION OF THE APPLE.

With the trees carefully planted, the management thereafter is comparatively easy, and should be successful with intelligent labor, which is applied mainly to cultivation, pruning, and protection from injurious insects and other enemies. Each tree should be carefully watched, and every means should be employed for giving it the best possible conditions for health and vigor, with a view to producing first-class fruit, which will command highest market prices. To accomplish this will require thorough tillage from early spring until midsummer, when all cultivation should cease and some cover crop be sown. This will cause the tree to close up its growth and mature its wood and buds and enable it to withstand a low degree of temperature. This is especially applicable to sections of country subject to extreme changes in climatic conditions. Among the desirable cover-crop plants are the clovers and legumes, such as cowpeas, beans, vetches, etc. These cover crops not only protect the roots of the trees from extreme cold and prevent the washing of the land by spring and fall rains, but afford a supply of humus so essential for the maintenance of the fertility of the soil and its physical condition; they also serve as a mulch, preventing the evaporation of moisture during drought. To obtain best results, cover crops should be turned under

early in the spring by plowing shallow, so as not to disturb the roots of the trees. All subsequent cultivation, which has primarily for its object the pulverizing of the soil to form a mulch for the retention of moistures, should be done with a two-horse cultivator, such as farmers use in corn culture, or a disk harrow, followed by a smoothing harrow. These implements should be used as soon as possible after every rainstorm, so as to maintain the surface mulch, which is essential for preventing the escape of moisture and for releasing plant food. If the land is level, all cultivation should be done so as to work the soil toward the tree row, which will leave the land gently sloping to an open center space between the rows, thus forming surface drainage. Cultivation in some form will be necessary each year until the trees have attained a size and age sufficient for bearing a crop of fruit, when the land may be seeded down with clover. This will have a tendency to change the buds of extension into fruit buds, and thus bring the orchard into bearing much sooner than it would if allowed to continue its rapid growth. Anything that checks the growth of the tree will produce the effect of causing it to bear fruit. In no case should any part of the clover crop be removed from the land, but it should be allowed to fall and decay upon the ground. By this treatment a large amount of decaying vegetable matter rich in plant food will accumulate upon the land and furnish protection from hot sun in summer and deep freezing in winter. Once in two or three years this may be plowed under, thus, to a great extent, restoring humus to the soil, which is very essential to the vigorous growth, health and longevity, and fruitfulness of the tree; besides such treatment saves the expense of using costly fertilizers. After one year of cultivation the land should be again reseeded, and the treatment repeated from time to time the same as with the first seeding.

The practice of growing some kind of a crop on the land between the rows of trees has become quite common as a matter of economy. This may be done for a few years after setting the tree without any detriment to the orchard, provided the crop is of such a nature as to require thorough cultivation and fertilization, so that instead of taking from the soil that which is necessary to the growth of the tree it will enrich it. To grow among the trees the first year of planting there is no better crop than corn; it requires thorough cultivation and affords a shade to the newly planted tree at the season when it most needs protection from the sun's greatest heat. Other crops, such as potatoes, cabbage, cucumbers, peas, beans, etc., may be grown to advantage, but in no case should small grain or grasses, which do not allow cultivation, be allowed. All the crops mentioned take from the soil plant food which will be needed in future for the orchard's support, and which should be returned in the form of some kind of manure. This can best be done, as already stated, by using well-decomposed

barnyard manure, which not only furnishes three principal elements of plant food (potash, nitrogen, and phosphoric acid), but also improves the physical character of the soil by the addition of humus, which such manure contains, and for this reason it is preferable to commercial fertilizers, which do not furnish the humus that is especially needed on dry clay lands. Commercial fertilizers may sometimes be used to advantage when there is sufficient humus in the soil but a lack of the elements of plant food—potash, nitrogen, and phosphates; but in soils without the humus the benefit of such fertilizers is questionable. (Pls. LXXXVIII and LXXXIX, fig. 1.)

PRUNING THE APPLE TREE.

Pruning and training are important factors in the successful management of an apple orchard. The objects to be attained are (1) symmetrical and evenly balanced heads, and (2) the admission of sunlight and free circulation of air into all parts of the tree top while maintaining a sufficient density of foliage to protect the trunks, branches, and fruit from the direct rays of the sun, which are liable to scald and injure both tree and fruit. All pruning and training possible should be done while the trees are young and the wood growth tender, as the healing over is more rapid and complete and the tree suffers less injury by the operation.

If the trees are 1 or 2 years old when set they should be cut back to the height from the ground it is proposed to form the head of the tree. This cutting back will cause several of the upper buds to grow, which will form the head at the proper height. These should be watched and only such left to grow as are to form the main branches. Those left should be the strongest shoots at equal distances apart around the stem, and should tend to an outward growth to spread and make an open head. Much of this pruning and training if performed at the proper time can be done by rubbing off the buds or pinching back the tender branches with the thumb and finger.

In all pruning done to give the desired form to the head, and especially while the tree is young, the orchardist should keep clearly fixed in his mind the future form of the tree, that is, what it should be when old; for what may seem to be an open head when young may prove when the trees are older to be too dense and crowded and the branches too closely formed together for convenience in getting around the tree for gathering the fruit or in giving it the necessary pruning. If at any time it should become necessary to remove limbs of considerable size, the wound should be covered with some substance, such as grafting wax, shellac varnish, or paint, to prevent drying and checking of the wood, which admits moisture and causes decay.

During early springtime, or even late winter (when the wood is not frozen each year), every tree should be carefully looked over,

and all branches which are liable to interfere with adjoining ones should be cut out and the centers of the dense growth thinned out; side branches which are making a stronger growth than others should be checked by heading in the terminal or central shoots, and all parts of the tree should be cut back whenever necessary to maintain an evenly balanced head. Some varieties have an upright habit of growth and some make slender growth; such need close attention each year in cutting back one-half of last year's wood growth, leaving the top bud on the side of the branch facing the direction to which it is intended to divert the growth. By this treatment there will be no difficulty in shaping the tree into any desired form. Open spaces in the tree may be closed up, as, for instance, when the tree has been deprived of a necessary branch by accident or otherwise the loss may be recovered in time by pruning the adjoining branches so as to divert the growth into the portion made bare of branches.

There is a diversity of opinion among orchardists as to the proper height at which to form the top or head of an apple tree. Formerly from 4 to 5 feet was the common practice of training apple trees, but 2 to 3 feet is now conceded to be preferable.

The objection to low-headed trees on account of the difficulty in cultivating the land has been overcome by practical experience and improved implements. A careful teamster will do less damage to a low-headed tree than to one with a high top. With the improved implements now in use, thorough tillage can be performed as well among low-headed trees as among those with high tops. There is less danger from high winds with the low heads, and pruning can be performed with greater facility and ease, while the saving in expense of gathering the fruit is quite an item; but the more important advantage gained by the low head is the protection of the body of the tree from the rays of the sun, causing, as stated, what is known as sun scald, which is very prevalent in some sections of the apple-growing region. Another point gained by the low head is in conservation of moisture and lower temperature around the base of the tree. No arbitrary rule, however, should be laid down as to the height of a fruit tree. This may depend upon the locality, exposure, variety, and desire of the planter. Some varieties have an upright habit of growth, while others have a drooping or horizontal habit, each requiring a training according to its requirements; but whatever difference of opinion there may be on this subject, it is now generally conceded that the low top, all things considered, is preferable.

There are three forms that are generally adopted in this country. One known as the vase or goblet form, which prevails to a large extent in the Pacific coast region, where by long experience it has been found to be best suited to the conditions of that section. This

form is obtained by cutting out the central stock or leader and training by a system of pruning into the shape of a vase or goblet. The pyramidal form is the opposite of the vase form, in that the main stock or leading shoot of the tree is allowed to maintain its upright growth and the side branches are shortened back so as to produce the form of a pyramid. There is, however, a modified form between the vase and the pyramid, which gives a round, symmetrical shape to the tree, sufficiently open to allow of free circulation of air and sunlight. This form is more generally adopted, and gives better satisfaction throughout the Central and Eastern apple-growing regions.

Protection from damage to young trees by mice and rabbits during the winter months should be provided. Anything that affords a harbor to mice, such as grass, weeds, or leaves, should be removed from around the trunks of trees. For preventing rabbits from gnawing the bark from young orchard trees, which is very important, many methods have been devised. The most effective plan is to tie some material around the body of the tree to the height of 2 feet or more. Cornstalks or rye straw, cut the desired length, serve the purpose very well. Building paper, plain or tarred, tied around the trees is effective and economical. This paper protection, by leaving it on the tree during the summer, may also serve to prevent the beetle of the apple-tree borer from depositing its eggs in the buds of the tree.

INSECTS AND DISEASES AFFECTING THE APPLE.[1]

Among the obstacles and drawbacks with which the apple grower has to meet and contend are the numerous insect enemies and diseases to which the fruit is subject. From the very beginning of his planting of trees he must exercise eternal vigilance and warfare on these foes to successful orcharding. Even before planting the orchardist must be on the alert for root aphis, which may already infest the roots of the trees when taken from the nursery, and if discovered these enemies should be exterminated at once by immersing the roots of the trees in a decoction of tobacco before planting.

The next enemy encountered after planting will be the borers, of which there are two species—the round-headed and the flat-headed apple tree borers. These are very destructive to young orchards, and nothing but extreme watchfulness and vigilance will prevent them from working great harm to the trees. The use of the knife and the probe are the most effective remedies when the insect has once found lodgment in the tree. The orchard should be gone over twice or three

[1] It is not the scope nor purpose of this paper to treat of insects or diseases in detail, but only to call the attention of the apple grower to some of the more important in a cursory way. For more complete information on this subject, the reader is referred to publications by the Entomologist and Pathologist of the Department of Agriculture, which may be obtained on application to the Department.

times during the growing season and diligent search made for the pest in its haunts, where it is readily found by observing the chips it has cast out of the trunk of the tree. In the case of the round-headed species the larva will be found either above or below the surface of the ground, and the borer may be removed or killed in its den by a piece of malleable wire for a probe, which will bend in following its burrows.

The use of some substance, as previously stated, wrapped around the body of the tree 2 or more feet in height will prevent the beetle from depositing its eggs in the tree; and the old saying here holds good, "An ounce of prevention is worth a pound of cure."

The root aphis and the borers have been mentioned first as affecting the trees, but the greatest enemy to apple culture is the codling moth, which damages the fruit to an alarming extent, and is more difficult to combat than most other insects. It is the most universally distributed of all the insects injurious to the apple. The loss to the commercial apple grower caused by this pest in this country can hardly be estimated. Where the proper efforts are made in the most intelligent and up-to-date way, codling moth damage may be kept down to less than 10 per cent, but in a large part of the country orchardists seem not to be willing to go to the expense or trouble involved in the operations. In the far Northwest the codling moth seems to be especially injurious, and the Department of Agriculture is now investigating the causes of this increasing injury.

In some of the Western and Northwestern States, where the climatic conditions seem to be most favorable for the propagation of this insect, it is rapidly on the increase, and nothing but the most stringent measures and constant vigilance will keep it under control. Spraying with some of the arsenites is the principal remedy and preventive now in use, but this alone is not a perfect success. Nature steps in to assist man in checking the increase of this insect by introducing its enemy, the Ichneumon fly. This fly lays its eggs in the codling moth, and these eggs hatch out grubs, which kill the insect.

Among other injurious insects to the apple are the tent caterpillars, which are easily destroyed; the cankerworm; also the several scale insects, including the San Jose species, which seems to be spreading over the country rapidly, and should be most vigorously guarded against, since its natural enemy has not yet been introduced or multiplied in sufficient numbers to hold it in check.

The apple scab and bitter rot are perhaps the two more important diseases to which the apple is subject, and they are deserving of close attention. They can be controlled or checked very much by spraying with formulas recommended by the Pathologist. All of the fungous diseases, in fact, are more or less checked when thorough spraying is practiced. (Pl. XC.)

FIG. 1.—APPLE ORCHARD OF F. H. SPEAKMAN, NEOSHO, MO., SEPTEMBER 18, 1901.
[Grimes and Jonathan varieties, with cowpeas between rows.]

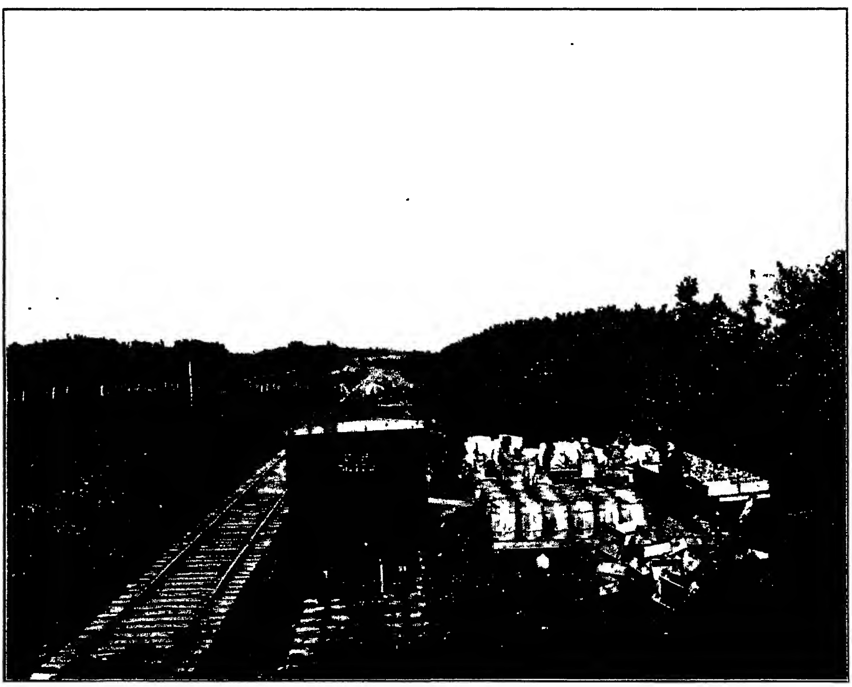
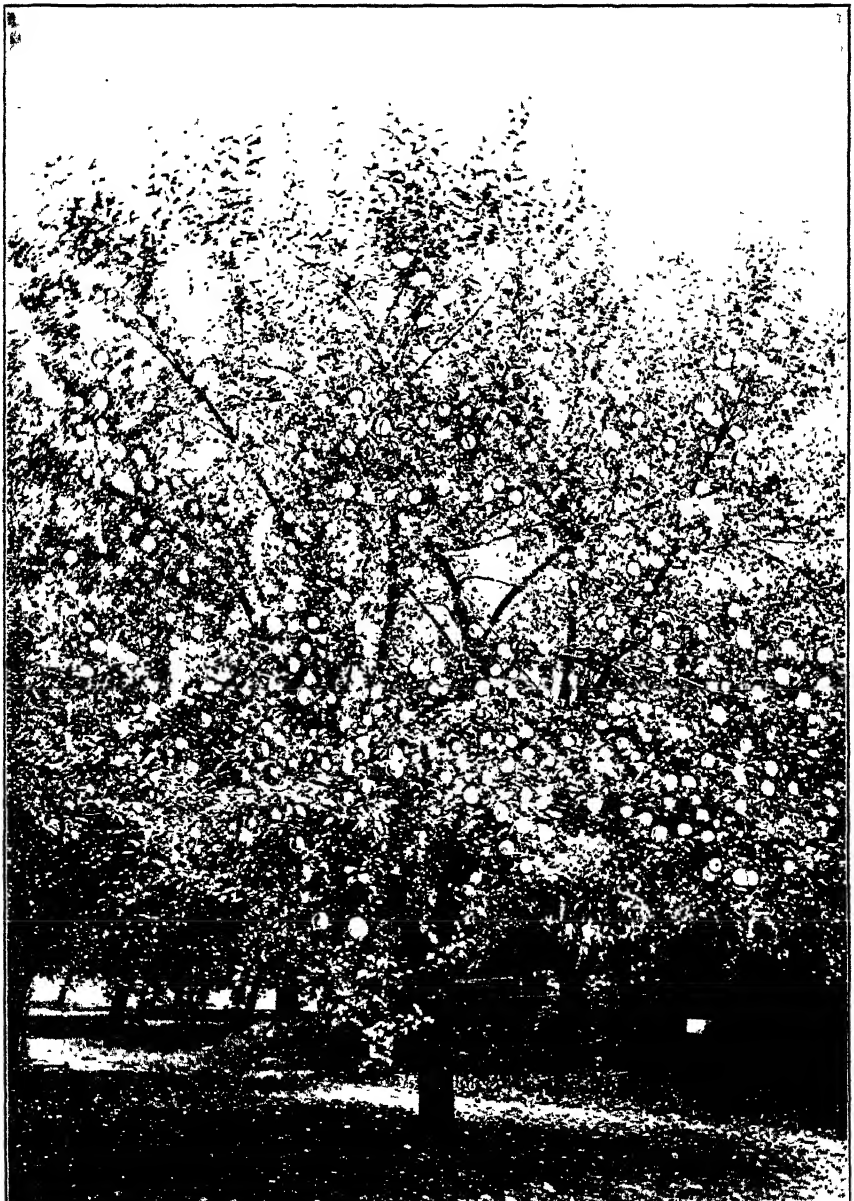


FIG. 2.—APPLE-PACKING OUTFIT OF FRED. WELHOUSE, MOORE, KANS, SEPTEMBER 20, 1901.



NORTHERN SPY APPLE TREE.

[Photograph furnished by J. Craig.]

HANDLING AND DISPOSITION OF APPLE CROPS.

The financial success of a commercial apple orchard depends largely upon the methods used in picking, sorting, packing, and disposing of the crops. These operations involve a large share of the expense of the enterprise; hence the owner should carefully study and investigate the most recent and economical methods in practice by others before he adopts any. If the crops are rightly handled there will be no difficulty in finding a ready market for choice first-class winter apples.

All fruit must be carefully hand picked, avoiding bruising or breaking of the skin or straining of the stem at its juncture with the apple, for a loosening of the stem at its base will induce rot to set in as quickly as the breaking of the skin. Some orchardists use for a picking receptacle a convenient-sized basket, lined or padded to avoid bruising, with an adjustable bale, so as to allow the fruit to be carefully dumped in piles under the shade of trees. To the piles barrels are hauled and distributed for packing, and a gang of sorters and packers follow, sorting and packing the fruit into the barrels. Another method is to use a 2-bushel grain sack which has its ends so fastened together with a strap or cord that it can be swung under the left arm, the strap crossing the right shoulder, and the open end of the sack, with a hoop in it to keep it open, resting on the breast, thus enabling the picker to use both hands.

A platform wagon filled with open-headed barrels follows the pickers between rows, and the fruit is emptied from the sacks into the barrels until filled, when the load is drawn to a packing house (constructed on the premises) provided with long sorting tables, where it is dumped. The fruit is sorted and packed direct from the tables into the barrels.

The time for picking the apple must be determined by its maturity or stage of ripeness, and not by any particular date. Some varieties should be picked much earlier than others, for upon the stage of maturity and time of picking depend largely the keeping quality of the apple. Sometimes a difference of one or two weeks in date of picking will show marked difference in keeping. If the apple is left on the trees after it is fully matured the ripening process will go on more rapidly than if taken off and placed in a cool room or cellar or taken at once to cold storage. It is better to be on the safe side and pick the fruit a little before maturity rather than to leave it until overripe. The common practice of allowing the fruit to remain in heaps under the trees for several days is a mistake. The sooner the apple is removed after picking to the cool cellar or to cool storage the better will it keep.

Careful and systematic sorting is an important matter in handling

fruit. The old adage, "Honesty is the best policy," will apply to this case. No imperfect, unsound, or blemished fruit should be allowed in the first-class No. 1 grade. The grading should be uniform. Any small specimens, as well as oversized ones, detract from the appearance of the whole lot in the package. The standard size should be an average of the variety when well grown; to be first-class it should be in regular form, free from fungous disease, and of clear color, to become attractive in the market. If the sorting and grading is honestly and faithfully done there will be no difficulty in finding a ready paying market for first-class winter apples. The requirements of the National Apple Shippers' Association on grading are worthy of consideration by the commercial orchardist, and are quoted, as follows:

> The standard size for No. 1 apples should not be less than $2\frac{1}{2}$ inches in diameter, and shall include such varieties as Ben Davis, Willow Twig, Baldwin, Rhode Island, and other varieties kindred in size. That the standard for such varieties as Romanite-Russet, Wine-sap, Jonathan, Missouri Pippin, and other varieties kindred in size shall be not less than $2\frac{1}{4}$ inches. And, further, that No. 1 apples shall be at time of packing practically free from the action of worms, defacement of surface, or breaking of skin; shall be hand picked from the tree, a bright and normal color, and shapely form.
>
> No. 2 apples shall be hand picked from the tree; shall not be smaller than $2\frac{1}{4}$ inches in diameter. The skin must not be broken nor the apple bruised. This grade must be faced and packed with as much care as No. 1 fruit.

Every orchard of considerable size should be provided with some sort of a storage house, either for temporary or permanent storage of apples, for without such place the orchardist is liable to loss and inconvenience. The storage house should have ventilation, and be opened by night and closed by day, so as to control the temperature in a manner to secure the right condition for preserving the fruit. It should also be constructed so as to have conveniences for sorting and packing the fruit as it is brought from the orchard. A fruit house, if properly constructed with air spaces in the walls, will serve to keep out frost, so that the grower may hold his fruit for a considerable length of time, thus giving him better opportunity for disposing of his crop.

Packages and packing are among the essential items of a well-managed orchard. (Pl. LXXXIX, fig. 2.) The package almost wholly in use in the Eastern, Middle, and Western States is the apple barrel adopted by the National Apple Shippers' Association, which is of standard size, $17\frac{1}{8}$ inches in diameter of head and $28\frac{1}{2}$ inches in length of stave, with bulge not less than 64 inches, outside measurement.

The box package is used entirely on the Pacific coast and in the States of the Northwest, and for several reasons this is preferable to the barrel. It is better suited for the retail trade, as small consumers can better afford to buy fruit in such a package than in a barrel. It is more convenient for handling, and occupies less space in shipping; it also carries the idea of a finer quality, doubtless on the principle that the

"best article is put up in smallest packages." Another advantage it has over the barrel is that it can be made much more attractive by use of display labels, such as are used for oranges, lemons, and other fine fruits. This kind of package will in time supersede all others for both the wholesale and retail trade. There is at present no standard size for the box package, but the one most commonly in use, and claimed by some to be the regulation size, measures inside $9\frac{3}{4}$ inches high by $10\frac{3}{4}$ inches wide by $20\frac{3}{4}$ inches long, and holds about 1 bushel, or nearly 50 pounds, of apples, varying slightly according to variety. If this package is used, the fruit should be carefully graded to uniform size and packed in layers; if wrapped in paper similar to that used for oranges, it will be found to keep better and will command a higher price than the unwrapped fruit. A fancy display label bearing the name of the variety and the name and address of the grower or dealer should be put on each box.

If honest work is done in grading and packing, the owner can soon gain a reputation, so that as soon as his brand is seen the purchaser knows at once what he may expect to find all through the package when it is opened. A smaller-sized box, holding about one-half a bushel, would be still more convenient for the small purchaser in the retail trade.

If the barrel package is used it should be set on end, and after removing the upper head, firmly pack at the bottom two layers of apples, which should be a fair sample of the entire contents of the barrel; arrange the layers so that the stem end of the apples will face downward. Then fill the barrel loosely until about half full; gently but thoroughly shake the fruit down, then fill the balance of the barrel, rounding it up to a little more than full; the head is then put on and pressed down into place with a screw or lever and the hoops put on and nailed fast. The ends of the barrel are reversed, and on the end having the faced layers should be marked the true name of the variety inclosed and the name of the grower or packer; this label will indicate the end to be opened.

It is quite a common practice among many extensive orchardists to sell their entire crop of apples while on the trees, the purchaser doing all the work of picking, sorting, and packing. When the proprietor possesses sufficiently good judgment to be able to closely approximate a safe valuation of the crop, and a fair price is offered, this is an economical and satisfactory way of disposing of a crop, as there is much hard, vexatious work, and more or less risk to run in gathering, packing, and handling of the crop. But in case the owner chooses to handle his crop, an immediate sale, as soon as it is barreled and ready for the market, is considered the safest and surest way to dispose of it. The holding over for a better price in future is more or less risky, and oftentimes results in loss from shrinkage and sometimes

the necessity of re-sorting and packing, which would require more of an advance in the market price to make the loss good than often occurs.

All of the crop left after assorting out the No. 1 and No. 2 grades should be classed and treated as culls, and sold to evaporating and canning establishments or to cider makers, unless the owner has all the facilities at hand for working them up. For extensive orchards the profits on the by-products will justify the expenditure for buildings and machinery necessary for working them up. In some instances the by-products of the orchard have been known to exceed in value returned the receipts from the main crop. Of course, such were exceptional cases. It is also true that no permanent profit ever comes to the producer who would compel his good fruit to sell his culls for him.

APPENDIX.

SUMMARY OF INFORMATION ON VARIOUS SUBJECTS OF INTEREST TO THE FARMER.

CONTENTS.

APPENDIX.

ORGANIZATION OF THE DEPARTMENT OF AGRICULTURE, DECEMBER 31, 1901.

SECRETARY OF AGRICULTURE, James Wilson.

The Secretary of Agriculture is charged with the supervision of all public business relating to the agricultural industry. He makes such regulations for interstate traffic in live stock as may be necessary to prevent transmisson of contagious diseases, and has charge of all interstate quarantine. He directs the admission or exclusion of live animals from foreign countries, and has charge of quarantine stations for importing cattle. He conducts the inspection and regulates the conditions of shipment of live stock and of meat products exported from American ports. He exercises advisory supervision over the agricultural experiment stations deriving support from the National Treasury.

ASSISTANT SECRETARY OF AGRICULTURE, Joseph H. Brigham.

The Assistant Secretary performs such duties as may be required by law or prescribed by the Secretary. He also becomes Acting Secretary of Agriculture in the absence of the Secretary.

CHIEF CLERK, Andrew Geddes.

The Chief Clerk has the general supervision of the clerks and employees; of the enforcement of the general regulations of the Department; and of the buildings occupied by the Department of Agriculture.

APPOINTMENT CLERK, Joseph B. Bennett.

The Appointment Clerk is charged by the Secretary with the preparation of all papers involved in making appointments, transfers, promotions, reductions, furloughs, and removals, and with all correspondence of the Department with the United States Civil Service Commission. He receives all certificates issued by that Commission to the Department, and deals with all questions affecting positions in the classified service. He is custodian of the Department seal.

CHIEF OF SUPPLY DIVISION, Cyrus B. Lower.

The Supply Division has charge of purchases of supplies and materials paid for from the general funds of the Department.

BUREAUS, DIVISIONS, AND OFFICES.

WEATHER BUREAU (corner Twenty-fourth and M streets NW.).—*Chief*, Willis L. Moore; *Chief Clerk*, Henry E. Williams; *Professors of Meteorology*, Cleveland Abbe, F. H. Bigelow, Alfred J. Henry, Charles F. Marvin, Edward B. Garriott.

The Weather Bureau has charge of the forecasting of weather; the issue of storm warnings; the display of weather and flood signals for the benefit of agriculture, commerce, and navigation; the gauging and reporting of rivers; the maintenance and operation of seacoast telegraph lines, and the collection and transmission of marine intelligence for the benefit of commerce and navigation; the reporting of temperature and rainfall conditions for the cotton, rice, sugar, and other interests; the display of frost and cold-wave signals; the distribution of meteorological information in the interests of agriculture and commerce; and the taking of such meteorological observations as may be necessary to establish and record the climatic conditions of the United States, or as are essential for the proper execution of the foregoing duties.

BUREAU OF ANIMAL INDUSTRY.—*Chief*, D. E. Salmon; *Assistant Chief*, A. D. Melvin; *Chief Clerk*, S. R. Burch; *Chief of Inspection Division*, A. M. Farrington; *Chief of Miscellaneous Division*, Richard W. Hickman; *Chief of Pathological Division*, Charles Wardell Stiles; *Chief of Biochemic Division*, E. A. de Schweinitz; *Chief of Dairy Division*, Henry E. Alvord; *Expert in Dairy Chemistry*, G. E. Patrick; *Zoologist*, John R. Mohler; *In charge of Experiment Station*, E. C. Schroeder; *Editorial Clerk*, George F. Thompson.

The Bureau of Animal Industry makes investigations as to the existence of contagious pleuro-pneumonia and other dangerous communicable diseases of live stock, superintends the measures for their extirpation, makes original investigations as to the nature and prevention of such diseases, and reports on the condition and means of improving the animal industries of the country. It also has charge of the inspection of import and export animals, of the inspection of vessels for the transportation of export cattle, and of the quarantine stations for imported neat cattle; supervises the interstate movement of cattle, and inspects live stock and their products slaughtered for food consumption.

BUREAU OF CHEMISTRY.—*Chemist and Chief*, Harvey W. Wiley; *Assistant Chief*, Ervin E. Ewell; *Chief, Food Laboratory*, W. D. Bigelow; *Chief, Sugar Laboratory*, G. L. Spencer; *Chief, Road-Material Laboratory*, L. W. Page; *Chief, Dendro-Chemical Laboratory*, W. H. Krug; *Chief, Insecticide and Agricultural Water Laboratory*, J. K. Haywood; *Chief, Soil Analysis Laboratory*, C. C. Moore.

The Division of Chemistry makes investigations of the methods proposed for the analyses of soils, fertilizers, and agricultural products, and such analyses as pertain in general to the interests of agriculture. It can not undertake the analyses of samples of the above articles of a miscellaneous nature, but application for such analyses should be made to the directors of the agricultural experiment stations of the different States. The division does not make assays of ores nor analyses of minerals, for other than agricultural purposes, except when related to general agricultural interests, nor analyses of water. The Bureau does the chemical work of some of the other Bureaus and Divisions of the Department and for other departments of the Government which apply to the Secretary of Agriculture for such assistance.

BUREAU OF PLANT INDUSTRY.—*Chief*, Beverly T. Galloway; *Chief Clerk*, James E. Jones; *Chief Vegetable Pathologist and Physiologist*, A. F. Woods; *Botanist*, F. V. Coville; *Agrostologist*, W. J. Spillman; *Pomologist*, G. B. Brackett; *Horticulturist*, L. C. Corbett.

The Bureau of Plant Industry studies plant life in all its relations to agriculture. It includes Vegetable Pathological and Physiological Investigations; Botanical Investigations and Experiments; Pomological Investigations; Grass and Forage Plant Investigations; Experimental Gardens and Grounds; the Arlington Experimental Farm; Congressional Seed Distribution; Seed and Plant Introduction; and Tea Culture Experiments.

OFFICE OF EXPERIMENT STATIONS.—*Director*, A. C. True; *Assistant Director*, E. W. Allen; *Irrigation Expert*, Elwood Mead; *Nutrition Expert*, W. O. Atwater; *Special Agent, Alaska*, C. C. Georgeson; *Special Agent, Hawaii*, Jared G. Smith; *Special Agent, Porto Rico*, F. D. Gardner.

The Office of Experiment Stations represents the Department in its relation to the experiment stations which are now in operation in all the States and Territories. It seeks to promote the interests of agricultural education and investigation throughout the United States. It collects and disseminates general information regarding the colleges and stations, and publishes accounts of agricultural investigations at home and abroad. It also indicates lines of inquiry of the stations, aids in the conduct of cooperative experiments, reports upon their expenditures and work, and in general furnishes them with such advice and assistance as will best promote the purposes for which they were established. It is also charged with investigations on the nutritive value and economy of human foods. The collection of valuable matter on irrigation from agricultural colleges and other sources, as provided in the appropriation bill, is conducted by this office.

BUREAU OF FORESTRY.—*Forester and Chief*, Gifford Pinchot; *Assistant Foresters*, Overton W. Price and George B. Sudworth; *Chief Clerk*, O. J. J. Luebkert.

The Bureau of Forestry investigates methods and trees for planting in the treeless West, gives practical assistance to tree planters, and also to farmers, lumbermen, and others, in handling forest lands. It studies commercial trees to determine their special values in forestry, and also studies forest fires and other forest problems.

BUREAU OF SOILS.—*Chief,* Milton Whitney; *Chief Clerk,* A. G. Rice; *Soil Physicist,* Lyman J. Briggs; *Soil Chemist,* Frank K. Cameron; *In charge United States Soil Survey,* Thos. W. Means; *In charge of Insular Soil Survey,* Clarence W. Dorsey; *In charge of Soil Management,* Franklin H. King; *Tobacco Expert,* Marcus L. Floyd.

The Bureau of Soils is intrusted with the investigation, survey, and mapping of soils; the investigation of the cause and prevention of the rise of alkali in the soil, and the drainage of soils; and the investigation of the methods of curing and fermentation of tobacco in the different tobacco districts.

DIVISION OF STATISTICS.—*Statistician and Chief,* John Hyde; *Assistant Statistician,* Stephen D. Fessenden.

The Division of Statistics collects information as to the condition, prospects, and harvests of the principal crops, and of the numbers, condition, and values of farm animals, through separate corps of county, township, and cotton correspondents, and individual farmers; and through State agents, each of whom is assisted by a corps of local reporters throughout the State. It obtains similar information from European countries monthly through consular, agricultural, and commercial authorities. It collects, tabulates, and publishes statistics of agricultural production, distribution, and consumption, the authorized data of governments, institutes, societies, boards of trade, and individual experts. It issues a monthly crop report and occasional bulletins for the information of the producers and consumers, and for their protection against combination and extortion in the handling of the products of agriculture.

SECTION OF FOREIGN MARKETS.—*Chief,* Frank H. Hitchcock; *Assistant Chief,* Frank R. Rutter.

The Section of Foreign Markets makes investigations and disseminates information "concerning the feasibility of extending the demands of foreign markets for the agricultural products of the United States."

DIVISION OF ENTOMOLOGY.—*Entomologist and Chief,* L. O. Howard; *Assistant Entomologist,* C. L. Marlatt.

The Division of Entomology obtains and disseminates information regarding injurious insects, investigates insects sent to the division in order to suggest appropriate remedies, conducts investigations in economic entomology in different parts of the country, and mounts and arranges specimens for illustrative and museum purposes.

DIVISION OF BIOLOGICAL SURVEY.—*Biologist and Chief,* C. Hart Merriam; *Assistant Chief,* T. S. Palmer.

The Division of Biological Survey studies the geographic distribution of animals and plants, and maps the natural life zones of the country; it also investigates the economic relations of birds and mammals, and recommends measures for the preservation of beneficial and the destruction of injurious species. It is charged with carrying into effect the provisions of the Federal law for the importation and protection of birds.

OFFICE OF PUBLIC ROAD INQUIRIES.—*Director,* Martin Dodge; *Assistant Director,* Maurice O. Eldridge.

The Office of Public Road inquiries collects information concerning the systems of road management throughout the United States, conducts investigations and experiments regarding the best method of road making, and prepares publications on this subject.

DIVISION OF PUBLICATIONS.—*Editor and Chief,* Geo. Wm. Hill; *Associate Editor,* Joseph A. Arnold; *Assistant Chief,* B. D. Stallings; *Assistant in Charge of Document Section,* R. B. Handy.

The Division of Publications exercises general supervision of the Department printing and illustrations, edits all publications of the Department (with the exception of those of the Weather Bureau), has charge of the printing and Farmers' Bulletin funds, and distributes all Department publications with the exception of those turned over by law to the Superintendent of Documents for sale at the price affixed by him; it issues, in the form of press notices, official information of interest to agriculturists, and distributes to agricultural publications and writers notices and synopses of Department publications.

DIVISION OF ACCOUNTS AND DISBURSEMENTS.—*Chief and Disbursing Clerk*, Frank L. Evans; *Assistant Chief* (in charge of Weather Bureau disbursements), A. Zappone; *Cashier*, Everett D. Yerby.

The Division of Accounts and Disbursements is charged with the adjustment of all claims against the Department; decides questions involving the expenditure of public funds; prepares estimates of appropriations needed; contracts for annual supplies, leases, and agreements; issues requisitions for the purchase of supplies, requests for passenger and freight transportation; and attends to all business relating to the financial interests of the Department, including payments of every description.

LIBRARY.—*Librarian*, Josephine A. Clark; *Assistant Librarian*, Claribel R. Barnett.

The Librarian has charge of the Library and supervises the arrangement and cataloguing of books, the preparation of bibliographies and similar publications, and the purchases of new books.

APPROPRIATIONS FOR THE DEPARTMENT OF AGRICULTURE FOR THE FISCAL YEARS ENDING JUNE 30, 1900, 1901, AND 1902.

Object of Appropriation.	1900.	1901.	1902.
Salaries, Department of Agriculture	$336,340.00	$328,680.00	$373,820.00
Furniture, Cases and Repairs, Department of Agriculture	10,000.00	....	....
Library, Department of Agriculture	5,000.00	5,000.00	7,000.00
Museum, Department of Agriculture	1,500.00	....	....
Postage, Department of Agriculture	2,000.00	....	....
Contingent Expenses, Department of Agriculture	25,000.00	37,000.00	37,000.00
Animal Quarantine Stations	12,000.00	50,000.00	25,000.00
Collecting Agricultural Statistics	110,000.00	110,000.00	120,000.00
Botanical Investigations and Experiments	20,000.00	30,000.00	45,000.00
Entomological Investigations	20,000.00	22,500.00	25,500.00
Vegetable Pathological Investigations	26,000.00	28,000.00	60,000.00
Biological Investigations	17,500.00	17,500.00	20,000.00
Pomological Investigations	9,500.00	9,500.00	20,000.00
Laboratory, Department of Agriculture	17,700.00	28,500.00	24,500.00
Forestry Investigations	40,000.00	80,000.00	146,280.00
Experimental Gardens and Grounds, Department of Agriculture	28,000.00	20,000.00	20,000.00
Soil Investigations	20,000.00	25,000.00	91,000.00
Grass and Forage Plant Investigations	12,000.00	17,000.00	20,000.00
Agricultural Experiment Stations [$765,000, 1900; $780,000, 1901; $789,000, 1902]	45,000.00	60,000.00	69,000.00
Nutrition Investigations	15,000.00	17,500.00	20,000.00
Public Road Inquiries	8,000.00	14,000.00	20,000.00
Publications, Department of Agriculture	80,000.00	105,000.00	173,000.00
Sugar Investigations	7,000.00	7,000.00	5,000.00
Purchase and Distribution of Valuable Seeds	130,000.00	170,000.00	270,000.00
Salaries and Expenses, Bureau of Animal Industry	950,000.00	1,000,000.00	1,050,000.00
Irrigation Investigations	35,000.00	50,000.00	50,000.00
Tea Culture Investigations	1,000.00	5,000.00	7,000.00
Arlington Experimental Farm	....	10,000.00	10,000.00
Plans for Building, Department of Agriculture	....	....	5,000.00
Total	1,983,540.00	2,245,180.00	2,714,100.00
WEATHER BUREAU.			
Salaries, Weather Bureau	153,320.00	153,320.00	159,820.00
Fuel, Lights and Repairs, Weather Bureau	8,000.00	9,000.00	9,000.00
Contingent Expenses, Weather Bureau	8,000.00	8,000.00	8,000.00
General Expenses, Weather Bureau	768,162.00	828,000.00	865,500.00
Meteorological Observation Stations	60,000.00	60,000.00	60,000.00
Building Addition to Weather Bureau Building, Washington	25,000.00	....	46,000.00
Total	1,022,482.00	1,058,320.00	1,148,320.00
Grand total	3,006,022.00	3,303,500.00	3,862,420.00

AGRICULTURAL COLLEGES AND OTHER INSTITUTIONS IN THE UNITED STATES HAVING COURSES IN AGRICULTURE.[a]

State or Territory.	Name of institution.	Location.	President.
Alabama	Alabama Polytechnic Institute.	Auburn	——— ———.
	Agricultural and Mechanical College for Negroes.	Normal	W. H. Councill, Ph. D.
Arizona	University of Arizona	Tucson	F. Y. Adams, M. A.
Arkansas	Arkansas Ind'l University	Fayetteville	J. L. Buchanan, LL. D.
	Branch Normal College	Pine Bluff	J. C. Corbin.
California	University of California	Berkeley	B. I. Wheeler, LL. D.
Colorado	The State Agricultural College of Colorado.	Fort Collins	B. O. Aylesworth, LL. D.
Connecticut	Conn. Agricultural College	Storrs	R. W. Stimson, M. A.[b]
Delaware	Delaware College	Newark	G. A. Harter, Ph. D.
	State College for Colored Students.	Dover	W. C. Jason, M. A.
Florida	Florida Agricultural College	Lake City	T. H. Taliaferro, Ph. D.
	Florida State Normal and Industrial College.	Tallahassee	N. B. Young, M. A.
Georgia	Georgia State College of Agriculture and Mechanic Arts.	Athens	H. C. White, Ph. D.
	Georgia State Industrial College.	College	R. R. Wright.
Idaho	University of Idaho	Moscow	J. A. McLean, Ph. D.
Illinois	University of Illinois	Urbana	A. S. Draper, LL. D.
Indiana	Purdue University	Lafayette	W. E. Stone, Ph. D.
Iowa	Iowa State College of Agriculture and the Mechanic Arts.	Ames	W. M. Beardshear, LL. D.
Kansas	Kansas State Agricultural College.	Manhattan	E. R. Nichols, M. A.
Kentucky	Agricultural and Mechanical College of Kentucky.	Lexington	J. K. Patterson, LL. D.
	State Normal School for Colored Students.	Frankfort	J. S. Hathaway, M. A., M. D.
Louisiana	Louisiana State University and Agricultural and Mechanical College.	Baton Rouge	T. D. Boyd, LL. D.
	Southern University and Agricultural and Mechanical College.	New Orleans	H. A. Hill.
Maine	The University of Maine	Orono	G. E. Fellows, Ph. D.
Maryland	Maryland Agricultural College.	College Park	R. W. Silvester.
Massachusetts	Massachusetts Agricultural College.	Amherst	H. H. Goodell, LL. D.
Michigan	Michigan State Agricultural College.	Agricultural College.	J. L. Snyder, Ph. D.
Minnesota	The University of Minnesota	St. Paul	C. Northrop, LL. D.
Mississippi	Mississippi Agricultural and Mechanical College.	Agricultural College.	J. C. Hardy, M. A.
	Alcorn Agricultural and Mechanical College.	Westside	W. H. Lanier, B. A.
Missouri	College of Agriculture and Mechanic Arts of the University of Missouri.	Columbia	R. H. Jesse, LL. D.
	Lincoln Institute	Jefferson City	E. A. Clarke, M. A.
Montana	The Montana College of Agriculture and Mechanic Arts.	Bozeman	J. Reid, A. B.
Nebraska	The University of Nebraska	Lincoln	E. B. Andrews, LL. D.
Nevada	Nevada State University	Reno	J. E. Stubbs, LL. D.
New Hampshire	The New Hampshire College of Agriculture and the Mechanic Arts.	Durham	C. S. Murkland, Ph. D.
New Jersey	Rutgers Scientific School (The New Jersey State College for the Benefit of Agriculture and the Mechanic Arts).	New Brunswick	Austin Scott, LL. D.
New Mexico	The New Mexico College of Agriculture and Mechanic Arts.	Mesilla Park	Luther Foster, M. S. A.
New York	Cornell University	Ithaca	J. G. Schurman, LL. D.
North Carolina	The North Carolina College of Agriculture and Mechanic Arts.	West Raleigh	G. T. Winston, LL. D.
	The Agricultural and Mechanical College for the Colored Race.	Greensboro	J. B. Dudley, M. A.
North Dakota	North Dakota Agricultural College.	Agricultural College.	J. H. Worst, LL. D.
Ohio	Ohio State University	Columbus	W. O. Thompson, D. D.
Oklahoma	Oklahoma Agricultural and Mechanical College.	Stillwater	A. C. Scott, LL. M.
	Agricultural and Normal University.	Langston	I. E. Page, M. A.

[a] Including only institutions established under the land-grant act of July 2, 1862.
[b] Acting.

AGRICULTURAL COLLEGES AND OTHER INSTITUTIONS IN THE UNITED STATES, ETC.—Continued.

State or Territory.	Name of institution.	Location.	President.
Oregon	Oregon State Agricultural College.	Corvallis	T. M. Gatch, Ph. D.
Pennsylvania	The Pennsylvania State College.	State College	G. W. Atherton, LL. D.
Rhode Island	Rhode Island College of Agriculture and Mechanic Arts.	Kingston	J. H. Washburn, Ph. D.
South Carolina	Clemson Agricultural College	Clemson College	H. S. Hartzog, LL. D.
	The Colored Normal, Industrial, Agricultural, and Mechanical College of South Carolina.	Orangeburg	T. E. Miller, LL. D.
South Dakota	South Dakota Agricultural College.	Brookings	J. W. Heston, LL. D.
Tennessee	University of Tennessee	Knoxville	C. W. Dabney, LL. D.
Texas	State Agricultural and Mechanical College of Texas.	College Station	D. F. Houston.
Utah	The Agricultural College of Utah.	Logan	W. J. Kerr, D. Sc.
Vermont	University of Vermont and State Agricultural College.	Burlington	M. H. Buckham, LL. D.
Virginia	Virginia Polytechnic Institute (State Agricultural and Mechanical College).	Blacksburg	J. M. McBryde, LL. D.
	The Hampton Normal and Agricultural Institute.	Hampton	H. B. Frissell, LL. D.
Washington	Washington Agricultural College and School of Science.	Pullman	E. A. Bryan, M. A.
West Virginia	West Virginia University	Morgantown	D. B. Purinton, LL. D.
	The West Virginia Colored Institute.	Institute	J. McH. Jones.
Wisconsin	University of Wisconsin	Madison	E. A. Birge, D. Sc.
Wyoming	University of Wyoming	Laramie	E. E. Smiley, D. D.[a]

[a] Acting.

AGRICULTURAL EXPERIMENT STATIONS OF THE UNITED STATES, THEIR LOCATIONS, DIRECTORS, AND PRINCIPAL LINES OF WORK.

Stations, locations, and directors.	Number on staff.	Number of teachers on staff.	Principal lines of work.
Alabama (College), Auburn: P. H. Mell	13	7	Botany; soils; analyses of fertilizers and food materials; field and pot experiments; horticulture; diseases of plants; feeding experiments; diseases of animals.
Alabama (Canebrake), Uniontown: J. M. Richeson	8	2	Soil improvement; field experiments; horticulture; floriculture; diseases of plants; diseases of animals.
Alabama (Tuskegee), Tuskegee: G. W. Carver	10	6	Field experiments and feeding experiments.
Arizona, Tucson: R. H. Forbes	8	2	Chemistry; botany; field experiments; improvement of ranges; horticulture (including date-palm culture); feeding experiments.
Arkansas, Fayetteville: R. L. Bennett	6	2	Chemistry of foods; field experiments; horticulture; diseases of plants; feeding experiments; diseases of animals.
California, Berkeley: E. W. Hilgard	22	12	Physics; chemistry and geographical distribution of soils; bacteriology; fertilizers; field crops; horticulture; botany; meteorology, technology of wine and olive oil, including zymology; beet-sugar chemistry; chemistry of foods and feeding stuffs; animal husbandry; entomology; dairying; drainage and irrigation; reclamation of alkali lands; plant introduction.
Colorado, Fort Collins: L. G. Carpenter	16	8	Chemistry; field experiments; horticulture; entomology; irrigation.

AGRICULTURAL EXPERIMENT STATIONS OF THE UNITED STATES, THEIR LOCATIONS, ETC.—Continued.

Stations, locations, and directors.	Number on staff.	Number of teachers on staff.	Principal lines of work.
Connecticut (State), New Haven: E. H. Jenkins	15	....	Analysis and inspection of fertilizers, foods, and feeding stuffs; chemistry; diseases of plants; horticulture; forestry; field experiments; entomology.
Connecticut (Storrs), Storrs: W. O. Atwater	7	2	Food and nutrition of man and animals; bacteriology of dairy products; field experiments; dairying.
Delaware, Newark: A. T. Neale	7	7	Chemistry; bacteriology; field experiments; horticulture; diseases of plants; feeding experiments; diseases of animals; entomology; dairying.
Florida, Lake City: T. H. Taliaferro	12	5	Chemistry; field experiments; horticulture; entomology.
Georgia, Experiment: R. J. Redding	8	1	Field experiments; horticulture; entomology; mycology; pig feeding; dairying.
Idaho, Moscow: J. A. McLean	11	9	Physics; botany; field experiments; horticulture; entomology; feeding experiments.
Illinois, Urbana: E. Davenport	25	14	Chemistry; bacteriology; field experiments; horticulture; forestry; diseases of plants; feeding experiments; entomology; dairying.
Indiana, Lafayette: C. S. Plumb	11	7	Chemistry; pot and field experiments; horticulture; feeding experiments; diseases of plants and animals.
Iowa, Ames: C. F. Curtiss	18	13	Chemistry; bacteriology; field experiments; horticulture; diseases of plants; feeding experiments; entomology; dairying.
Kansas, Manhattan: J. T. Willard	14	12	Soils; horticulture; seed breeding; field experiments; feeding and digestion experiments; diseases of animals; entomology; dairying.
Kentucky, Lexington: M. A. Scovell	11	1	Chemistry; soils; fertilizer analysis; field experiments; horticulture; diseases of plants; entomology; dairying.
Louisiana (Sugar), New Orleans: William C. Stubbs	....	....	Chemistry; bacteriology; soils and soil physics; field experiments; horticulture; sugar making; drainage; irrigation.
Louisiana (State), Baton Rouge: William C. Stubbs	23	5	Chemistry; geology; botany; bacteriology; soils; inspection of fertilizers and paris green; field experiments; horticulture; diseases of animals; entomology.
Louisiana (North), Calhoun: William C. Stubbs	....	....	Chemistry; soils; fertilizers; field experiments; horticulture; feeding experiments; stock raising; dairying.
Maine, Orono: C. D. Woods	13	6	Chemistry; botany; analysis and inspection of fertilizers, concentrated commercial feeding stuffs, and creamery glassware; horticulture; diseases of plants; seed tests; food and nutrition of man and animals; poultry raising; marine invertebrates; diseases of animals; entomology; dairying.
Maryland, College Park: H. J. Patterson	15	7	Chemistry; soils; field experiments; horticulture; diseases of plants; feeding experiments; entomology.
Massachusetts, Amherst: H. H. Goodell	19	8	Chemistry; meteorology; analysis and inspection of fertilizers and concentrated commercial feeding stuffs; field experiments; horticulture; electro-germination; diseases of plants; digestion and feeding experiments; diseases of animals; entomology; dairying.
Michigan, Agricultural College: C. D. Smith	14	7	Bacteriology; soils; field experiments; horticulture; diseases of plants; feeding experiments; diseases of animals; entomology; apiculture; stable hygiene.

AGRICULTURAL EXPERIMENT STATIONS OF THE UNITED STATES, THEIR LOCATIONS, ETC.—Continued.

Stations, locations, and directors.	Number on staff.	Number of teachers on staff.	Principal lines of work.
Minnesota, St. Anthony Park, St. Paul: W. M. Liggett	13	7	Chemistry, soils; field experiments; horticulture; forestry; diseases of plants; food and nutrition of man; plant and animal breeding; feeding experiments; diseases of animals; entomology; dairying.
Mississippi, Agricultural College: W. L. Hutchinson	10	6	Soils; fertilizers; field experiments; horticulture; animal husbandry; feeding experiments; diseases of animals; entomology; dairying.
Missouri (State), Columbia: H. J. Waters	12	6	Chemistry; field experiments; horticulture; diseases of plants; feeding experiments; diseases of animals; entomology; dairying; drainage.
Missouri (Fruit), Mountain Grove: J. T. Stinson	3	....	Horticulture.
Montana, Bozeman: S. Fortier	9	5	Chemistry; meteorology; field experiments; horticulture; feeding experiments; poultry experiments; entomology; irrigation.
Nebraska, Lincoln: E. A. Burnett	18	11	Chemistry; botany; meteorology; soils; field experiments; horticulture; forestry; feeding and breeding experiments; diseases of animals; entomology; irrigation.
Nevada, Reno: J. E. Stubbs	9	6	Chemistry; botany; soils; field experiments; horticulture; forestry; feeding experiments; animal diseases; entomology; irrigation.
New Hampshire, Durham: W. D. Gibbs	11	10	Chemistry; bacteriology; soil physics; field experiments; horticulture; diseases of plants; feeding experiments; entomology.
New Jersey (State), New Brunswick: E. B. Voorhees	11		
New Jersey (College), New Brunswick: E. B. Voorhees	8		of animals; entomology; dairy husbandry; bacteria of milk; irrigation.
New Mexico, Mesilla Park: Luther Foster	9	6	Chemistry; soil physics; field experiments; horticulture; entomology; irrigation.
New York (State), Geneva: W. H. Jordan	26	....	Chemistry; bacteriology; meteorology; fertilizers; analysis and control of fertilizers; inspection of creamery glassware; field experiments; horticulture; diseases of plants; feeding experiments; poultry experiments; entomology; dairying; irrigation.
New York (Cornell), Ithaca: I. P. Roberts	18	7	Chemistry of soils, feeding stuffs and dairy products; soils; fertilizers; field experiments; horticulture; diseases of plants; feeding sheep and swine; diseases of animals; poultry experiments; entomology; dairying.
North Carolina, Raleigh: B. W. Kilgore	14	5	Chemistry; soils; field experiments; horticulture; analysis of feeding stuffs; digestion experiments; animal husbandry; diseases of animals; poultry experiments.
North Dakota, Agricultural College: J. H. Worst	8	5	Field experiments; plant breeding; horticulture; diseases of plants; feeding experiments; diseases of animals; dairying.
Ohio, Wooster: C. E. Thorne	16	4	Soils; field experiments; horticulture; diseases of plants; breeding and feeding experiments; diseases of animals; entomology.
Oklahoma, Stillwater: John Fields	9	4	Field experiments; horticulture; forestry; diseases of plants; digestion and feeding experiments; animal husbandry; diseases of animals; entomology.

AGRICULTURAL EXPERIMENT STATIONS OF THE UNITED STATES, THEIR LOCATIONS, ETC.—Continued.

Stations, locations, and directors.	Number on staff.	Number of teachers on staff.	Principal lines of work.
Oregon, Corvallis: J. Withycombe	11	7	Chemistry; soils; field crops; horticulture; diseases of plants; digestion and feeding experiments; entomology; dairying.
Pennsylvania, State College: H. P. Armsby	17	7	Chemistry; meteorology; fertilizer analysis; field experiments; feeding experiments; dairying.
Rhode Island, Kingston: H. J. Wheeler	10	6	Chemistry; meteorology; soils; analysis and inpection of fertilizers and feeding stuffs; field and pot experiments; horticulture; poultry experiments.
South Carolina, Clemson College: H. S. Hartzog	15	7	Soils; analysis and control of fertilizers; field experiments; horticulture; plant breeding; diseases of plants; feeding experiments; veterinary science; entomology; dairying.
South Dakota, Brookings: J. W. Heston	12	6	Bacteriology; chemistry of soils and soil physics; field experiments; forestry; plant breeding; diseases of plants; feeding experiments; entomology; irrigation.
Tennessee, Knoxville: A. M. Soule	11	11	Chemistry; soils; fertilizers; field experiments; horticulture; seeds; weeds; diseases of plants; feeding experiments; entomology; dairying.
Texas, College Station: J. H. Connell	14	5	Chemistry; soils; field experiments; horticulture; diseases of animals; irrigation.
Utah, Logan: J. A. Widtsoe	14	9	Chemistry of soils and feeding stuffs; alkali soil investigations; meteorology; field experiments; horticulture; diseases of plants; cattle and sheep breeding; feeding experiments; dairying; poultry experiments; irrigation.
Vermont, Burlington: J. L. Hills	12	6	Chemistry; analysis and control of fertilizers and feeding stuffs; inspection of creamery glassware; field experiments; horticulture; diseases of plants; feeding experiments; dairying.
Virginia, Blacksburg: J. M. McBryde	11	5	Field crops; horticulture; feeding experiments; veterinary science; entomology; cider and vinegar making; ferments.
Washington, Pullman: E. A. Bryan	10	7	Chemistry; botany; bacteriology; soils; field experiments; horticulture; diseases of plants; feeding and breeding experiments; oyster culture; diseases of animals; entomology; dairying; irrigation.
West Virginia, Morgantown: J. H. Stewart	13	4	Chemistry; analysis and control of fertilizers; soils; field experiments; horticulture; inspection of orchards and nurseries; feeding experiments; poultry experiments; entomology.
Wisconsin, Madison: W. A. Henry	19	14	Chemistry; soils; field experiments; horticulture; feeding experiments; dairying; drainage and irrigation.
Wyoming, Laramie: E. E. Smiley	9	6	Geology; botany; meteorology; waters; soils; fertilizers; field experiments; food analysis; feeding experiments; entomology; irrigation.

STATE OFFICIALS IN CHARGE OF AGRICULTURE.

Secretary of Agriculture.

Pennsylvania	John Hamilton	Harrisburg.

Commissioners of Agriculture.[1]

Alabama	Robert R. Poole	Montgomery.
Arkansas	Frank Hill	Little Rock.
Florida		Tallahassee.
Georgia	O. B. Stevens	Atlanta.
Kentucky	I. B. Nall	Frankfort.
Louisiana	J. G. Lee	Baton Rouge.
Maine	A. W. Gilman	Augusta.
Montana	J. A. Ferguson	Helena.
New York	Chas. A. Wieting	Albany.
North Carolina	S. L. Patterson	Raleigh.
North Dakota	R. J. Turner	Bismarck.
South Carolina	A. P. Butler	Columbia.
Tennessee	Thos. H. Paine	Nashville.
Texas	Jefferson Johnson	Austin.
Virginia	Geo. W. Koiner	Richmond.
Washington	W. P. C. Adams	Olympia.

Secretaries of State Boards of Agriculture.

California	George W. Jackson	Sacramento.
Colorado	A. M. Hawley	Fort Collins.
Connecticut	J. F. Brown	North Stonington.
Delaware	Wesley Webb	Dover.
Illinois	W. C. Garrard	Springfield.
Indiana	Chas. Downing	Indianapolis.
Iowa	J. C. Simpson	Des Moines.
Kansas	F. D. Coburn	Topeka.
Maine	B. Walker McKeen	Augusta.
Massachusetts	J. W. Stockwell	Boston.
Michigan	Arthur C. Bird	Agricultural College.
Missouri	George B. Ellis	Columbia.
Nebraska	Robt. W. Furnas	Brownville.
Nevada	Louis Bevier	Carson City.
New Jersey	Franklin Dye	Trenton.
New Hampshire	N. J. Bachelder	Concord.
North Carolina	T. K. Bruner	Raleigh.
Ohio	W. W. Miller	Columbus.
Oregon	M. D. Wisdom	Portland.
Rhode Island	George A. Stockwell	Providence.
South Dakota	Walter B. Dean	Yankton.
Utah	H. P. Folsom	Salt Lake.
Vermont	C. J. Bell	East Hardwick.
West Virginia	J. B. Garvin	Charleston.
Wisconsin	John M. True	Madison.

Officials in charge of Agriculture.

Hawaii	Wray Taylor	Honolulu.
Porto Rico	Wm. H. Elliott	San Juan.
Philippine Islands	F. Lamson-Scribner	Manila.

SECRETARIES OF STATE AGRICULTURAL SOCIETIES.

Connecticut	B. W. Collins	Meriden.
Georgia	M. V. Calvin	Augusta.
Louisiana	W H. Dalrymple	Baton Rouge.

[1] In several States the duties of the Commissioner of Agriculture are joined with the care of other interests also, as of mining and labor.

SECRETARIES OF STATE AGRICULTURAL SOCIETIES—Continued.

Massachusetts	Leander F. Herrick	Worcester.
Maine	Geo. H. Clarke	Auburn.
Minnesota	E. W. Randall	Hamline.
Montana	Francis Pope	Helena.
Nevada	Wm. Hy. Doane	Reno.
New York	Edw. A. Callahan	Albany.
North Carolina	Joseph E. Pogue	Raleigh.
Pennsylvania	J. P. Nissley	Hummelstown.
South Carolina	T. W. Holloway	Pomaria.
Vermont	C. M. Winslow	Brandon.

OFFICIALS IN CHARGE OF FARMERS' INSTITUTES.

State.	Name of official.	Post-office.
Alabama	Robert R. Poole, Commissioner of Agriculture	Montgomery.
	C. A. Cary, Alabama Polytechnic Institute	Auburn.
Arkansas	W. G. Vincenheller, Agricultural Experiment Station	Fayetteville.
California	E. J. Wickson, University of California	Berkeley.
	D. T. Fowler, for Central and Northern California	Do.
	A. J. Cook, for Southern California	Claremont.
Colorado	B. O. Aylesworth, President State Agricultural College	Fort Collins.
Connecticut	J. F. Brown, Secretary State Board of Agriculture	West Cornwall.
	George E. Manchester, Secretary Connecticut Dairymen's Association.	Winsted.
	H. C. C. Miles, Secretary Connecticut Pomological Society	Milford.
Delaware	Wesley Webb, Superintendent Farmers' Institute for Kent County.	Dover.
	A. T. Neale, Superintendent for Newcastle County	Newark.
	S. H. Messick, Secretary for Sussex County	Bridgeville.
Florida	H. E. Stockbridge, Agricultural College	Lake City.
Georgia	H. C. White, President State College of Agriculture and Mechanic Arts.	Athens.
Illinois	A. B. Hostetter, Secretary and Superintendent of Farmers' Institutes.	Springfield.
	E. Davenport, Dean College of Agriculture, University of Illinois.	Urbana.
Indiana	W. C. Latta, Agricultural Experiment Station	Lafayette.
Iowa	J. C. Simpson, Secretary State Board of Agriculture	Des Moines.
	W. M. Beardshear, President State College of Agriculture and Mechanic Arts.	Ames.
Kansas	D. H. Otis, Professor Dairying, Agricultural College	Manhattan.
Kentucky	I. B. Nall, Commissioner of Agriculture	Frankfort.
	M. A. Scovell, Director Agricultural Experiment Station	Lexington.
Louisiana	L. Jastremski, Commissioner of Agriculture	Baton Rouge.
Maine	A. W. Gilman, Commissioner of Agriculture	Augusta.
Maryland	W. L. Amoss, Director Farmers' Institutes	Benson.
Massachusetts	J. W. Stockwell, Secretary State Board of Agriculture	Boston.
Michigan	C. D. Smith, Director Agricultural Experiment Station	Agricultural College.
Minnesota	O. C. Gregg, Superintendent Farmers' Institutes	Lynd.
Mississippi	W. L. Hutchinson, Director Agricultural Experiment Station.	Agricultural College.
Missouri	Geo. B. Ellis, Secretary State Board of Agriculture	Columbia.
Montana	J. Reid, President College of Agriculture and Mechanic Arts.	Bozeman.
Nebraska	E. A. Burnett, University of Nebraska	Lincoln.
New Hampshire	N. J. Bachelder, Secretary State Board of Agriculture	Concord.
New Jersey	F. Dye, Secretary State Board of Agriculture	Trenton.
New York	F. E. Dawley, Director of Institutes	Fayetteville.
North Carolina	S. L. Patterson, Commissioner of Agriculture	Raleigh.
North Dakota	E. E. Kaufman, Assistant Dairy Commissioner	Fargo.
Ohio	W. W. Miller, Secretary State Board of Agriculture	Columbus.
Oregon	J. Withycombe, Vice-director Agricultural Experiment Station.	Corvallis.
Pennsylvania	A. L. Martin, Deputy Secretary of Agriculture	Harrisburg.
Rhode Island	G. A. Stockwell, Secretary State Board of Agriculture	Providence.
South Carolina	H. S. Hartzog, President Clemson Agricultural College	Clemson College.
South Dakota	S. A. Cochrane, Director Farmers' Institute	Brookings.
Tennessee	T. H. Paine, Commissioner of Agriculture	Nashville.
	Andrew M. Soule, Director Agricultural Experiment Station.	Knoxville.
Texas	J. H. Connell, Director Agricultural Experiment Station	College Station.
Utah	W. J. Kerr, President Agricultural College	Logan.
Vermont	C. J. Bell, Secretary State Board of Agriculture	East Hardwick.
Virginia	G. W. Koiner, Commissioner of Agriculture	Richmond.
Washington	E. A. Bryan, Director Agricultural Experiment Station	Pullman.
West Virginia	D. M. Silliman, Institute Director	Charleston.
Wisconsin	G. McKerrow, Superintendent Farmers' Institutes	Madison.

MISCELLANEOUS STATE ORGANIZATIONS.

Name of organization.	Secretary.	Post-office.
Illinois Seed Corn Growers' Association	F. A. Warner	Sibley.
New York State Farmers' Congress	G. L. Flanders	Albany.
New York State Fair	S. C. Shaver	Do.
Nebraska Sugar Beet Growers' Association	W. N. Nason	Omaha.
Nebraska Veterinary Medical Association	A. T. Peters	Lincoln.
Nebraska Irrigation Association	Robert Oberfelder	Sidney.
Ohio Wool Growers' Association	W. N. Conden	Quaker City.
Texas Truck Growers' Association	J. G. Jones	San Antonio.
Texas Cotton Growers' Association	E. S. Peters	Calvert.
West Virginia Live Stock Association	C. C. Brown	Charleston.
West Virginia Sheep Breeders and Wool Growers' Association.	Jas. B. Beal	Wallsburg.
Wisconsin Butter Makers' Association	E. H. Farrington	Madison.
Wisconsin Tobacco Growers' Association	A. L. Fisher	Janesville.

IRRIGATION OFFICIALS AND ASSOCIATIONS.

State and Territorial irrigation officers.

States and Territories.	Name of official.	Post-office.
Arizona	F. P. Trott, commissioner	Phoenix.
Colorado	A. J. McCune, State engineer	Denver.
	John E. Field, deputy State engineer	Do.
	James J. Armstrong, superintendent Division No. 1	Do.
	E. R. Chew, superintendent Division No. 2	Pueblo.
	Wesley Staley, superintendent Division No. 3	Hooper.
	E. D. Samain, superintendent Division No. 4	
	A. F. Reeves, superintendent Division No. 5	Montrose.
	P. F. Reinhardt, superintendent Division No. 6	Steamboat Springs.
Idaho	D. W. Ross, State engineer	Boise.
Kansas	R. M. Wright, commissioner of forestry	Dodge City.
Montana	C. O. Reed, president of commission[a]	Helena.
	D. A. Corey, secretary of commission[a]	Do.
	H. B. Waters, commissioner[b]	Bozeman.
Nebraska	E. P. Savage, governor[c]	Lincoln.
	F. N. Prout, attorney-general[c]	Do.
	G. D. Follmer, commissioner public lands[c]	Do.
	Adna Dobson, State engineer	Do.
	H. O. Smith, under secretary for water division 1	Crawford.
	C. S. Spearman, under secretary for water division 2	Do.
Nevada	R. Sadler, governor[c]	Carson City.
	William Woodburn, attorney-general[c]	Do.
	E. D. Kelley, surveyor-general[c]	Do.
New Mexico	G. A. Richardson, president of commission	Roswell.
	G. W. Knaebel, secretary	Santa Fe.
	Frank Springer, commissioner	East Las Vegas.
	W. A. Hawkins, commissioner	Alamogordo.
	E. A. Miera, commissioner	Albuquerque.
	P. E. Harroun, engineer	Do.
South Dakota	James H. Sheppard, State engineer	Brookings.
Utah	A. F. Doremus, State engineer	Salt Lake.
Wyoming	Fred. Bond, State engineer[d]	Cheyenne.
	Frank Warner, assistant State engineer	Do.
	W. M. Gilcrest, superintendent Division No. 1	Do.
	C. B. Holmes, superintendent Division No. 2	Sheridan.
	B. B. Morton, superintendent Division No. 3	Ten Sleep.
	O. A. Hamilton, superintendent Division No 4	Rock Springs.

[a] Commission in charge of reclamation under Carey Act.
[b] Water commissioner appointed by court.
[c] State board of irrigation.
[d] State board of control.

Irrigation Associations.

The Irrigation Congress.—President, Thomas F. Walsh, Washington, D. C.; secretary, H. B. Maxon, Reno, Nevada.

National Irrigation Association.—President, Thomas F. Walsh, Washington, D. C.; secretary, John H. Fowler, Chicago, Ill.

The California Water and Forest Association.—President, William Thomas, San Francisco, Cal.; secretary, T. Cary Friedlander, San Francisco, Cal.

The Utah Irrigation Congress.—President, Abel J. Evans, Provo, Utah; secretary, George C. Lambert, Salt Lake, Utah.

STATE DAIRY OFFICIALS.

State.	Commissioner.	Post-office.
California	J. M. Thomas, Secretary	114 California street, San Francisco.
Colorado	T. L. Monson	Denver.
Connecticut	John B. Noble	Hartford.
Illinois	Alfred H. Jones	Room 1623 Manhattan Building, Chicago.
Indiana	J. N. Hurty (State Health Officer)	Indianapolis.
Iowa	B. P. Norton	Des Moines.
Massachusetts	George M. Whitaker, General Agent	Box 1332, Boston.
Michigan	W. B. Snow	Lansing.
Missouri	C. H. Eckels, ex-officio	Columbia.
Minnesota	W. W. P. McConnell	St. Paul.
Nebraska	S. C. Bassett	Lincoln.
New Jersey	George W. MacGuire	Trenton.
New York	Charles A. Wieting	Albany.
North Dakota	H. U. Thomas	Bismarck.
Ohio	Joseph E. Blackburn	Columbus.
Oregon	J. W. Bailey	Portland.
Pennsylvania	Jesse K. Cope	Harrisburg.
South Dakota	C. P. Sherwood	De Smet.
Utah	Moroni Heiner	Morgan City.
Washington	E. A. McDonald	Seattle.
Wisconsin	H. C. Adams	Madison.

DAIRY ASSOCIATIONS.

Name of organization.	Secretary.	Post-office.
National Association of State Dairy and Food Departments.	J. B. Noble	Hartford, Conn.
National Dairy Union	Charles Y. Knight	154 Lake st., Chicago.
National Creamery Buttermakers' Association	E. Sudendorf	Elgin, Ill.
New England Milk Producers' Union	W. A. Hunter	Rutland, Mass.
Five States Milk Producers' Association	H. T. Coon	Homer, N. Y.
Alabama Dairymen's Association	F. H. Bates	Hamburg.
California Creamery Operators' Association	W. H. Saylor	114 California street, San Francisco.
California Dairy Association	Samuel E. Watson	113 Davis street, San Francisco.
Dairymen's Association of Southern California	Horace G. Hamilton	211 N. Beaudry avenue, Los Angeles.
Connecticut Dairymen's Association	George E. Manchester	Station A, Winsted.
Connecticut Creamery Association	E. B. Little	Somers.
Georgia Dairymen's Association	M. L. Duggan	Sparta.
Illinois State Dairymen's Association	George Caven	154 Lake st., Chicago.
Chicago Milk Shippers' Union	H. B. Farmer	92 Lasalle st., Chicago.
Indiana State Dairy Association	H. E. Van Norman	Lafayette.
Idaho Dairy and Pure Food Association	A. E. Gipson	Caldwell.
Iowa State Dairy Association	J. C. Daly	Charles City.
Kansas State Dairy Association	T. A. Borman	505 Polk street, Topeka.
Maine Dairymen's Association	L. W. Dyer	Woodfords.
Massachusetts Creamery Association	A. M. Lyman	Montague.
Michigan Dairymen's Association	S. J. Wilson	Flint.
Minnesota State Dairymen's Association	J. R. Morley	Owatonna.
Minnesota State Butter and Cheese Makers' Association.	J. K. Bennett	Clinton Falls.
Missouri Dairymen's Association	Levi Chubbuck	1214 Chemical Building, St. Louis.
Nebraska Dairymen's Association	S. C. Bassett	Gibbon.
(N. H.) Granite State Dairymen's Association	Ivan C. Weld	Durham.
New Jersey State Dairy Union	G. L. Gillingham	Moorestown.
New York State Dairymen's Association	W. W. Hall	Gouverneur.
North Carolina State Dairymen's Association	C. W. Gold	Wilson.
North Dakota State Dairymen's Association	E. E. Kaufman	Fargo.
Ohio State Dairymen's Association	James S. Devol	Marietta.
Oregon Dairymen's Association	F. L. Kent	Corvallis.
Pennsylvania Dairy Union	H. Hayward	State College.
Creamery Association of E. Pennsylvania and vicinity.	George R. Meloney	1937 Market st., Philadelphia.
South Dakota Dairy and Buttermakers' Association	C. P. Sherwood	Desmet.
Texas Dairymen's Association	J. H. Tom	Georgetown.
Utah Dairymen's Association	F. B. Linfield	Logan.
Vermont Dairymen's Association	F. L. Davis	North Pomfret.
Washington State Dairymen's Association	D. S. Troy	Chimacum.
Wisconsin Dairymen's Association	George W. Burchard	Fort Atkinson.
Wisconsin Cheesemakers' Association	U. S. Baer	Madison.
Wisconsin Buttermakers' Association	E. H. Farrington	Madison.

PROTECTION AGAINST CONTAGION FROM FOREIGN CATTLE.

An act of Congress of August 28, 1894, prohibits the importation of cattle and cattle hides, but by the act of March 2, 1895, making appropriations for the Department of Agriculture, it is provided that the prohibition may be suspended by the President whenever the Secretary of Agriculture shall certify to the President what countries or parts of countries are free from contagious or infectious diseases of domestic animals. The President, by proclamation of November 8, 1895, lifted the embargo with reference to Norway, Sweden, Holland, Great Britain, Ireland, the Channel Islands, and the countries of North, Central, and South America so as to admit cattle under sanitary regulations prescribed by the Secretary of Agriculture; also from all countries so as to admit hides under regulations prescribed by the Secretary of the Treasury.

STOCK BREEDERS' ASSOCIATIONS.[1]

CATTLE.

American Aberdeen-Angus Breeders' Association.—Thomas McFarlane, Harvey, Ill., secretary. Number of registrations, 50,000; date of first entry, November, 1883. Registration fees: For animals under 1 year old, to members, $1.50, nonmembers, $2.50. Entries of ancestors to complete pedigrees, $1. Entries of native animals over 1 year old, $3 to members. $5 to nonmembers. Transfers free within 90 days, $1 after 90 days. Certified pedigrees, 50 cents: extended pedigrees, $1; duplicate certificates, 25 cents. Affiliated foreign society: Polled Cattle Society of Scotland, Dr. Alex. Ramsay, secretary, Banff, Scotland. Eligible[2] to registry: American-bred animals whose sires and dams are recorded in American book, but application must be made within 2 years of birth, and imported animals recorded or tracing to the eighth or a prior volume of the affiliated Scotch book.

American Devon Cattle Club.—L. P. Sisson, Newark, Ohio, secretary. Number of registrations: Bulls, 7,504; cows, 12,732. Registration fees: Members, $1; nonmembers, $2: transfers, 25 cents. Affiliated English books: Davies Devon Herd Book (England), 24 volumes: Canada Record of Devons. Eligible to register: Animals having sires and dams in Devon records or affiliated books.

American Galloway Breeders' Association.—Frank B. Hearne, Independence, Mo., secretary.

American Guernsey Cattle Club.—William H. Caldwell, Peterboro, N. H., secretary.

American Hereford Cattle Breeders' Association.—C. R. Thomas, 225 West Twelfth street, Kansas City, Mo., secretary.

American Jersey Cattle Club.—J. J. Hemingway, No. 8 West Seventeenth street, New York, N. Y., secretary.

American Polled Durham Breeders' Association.—Fletcher S. Hines, Indianapolis, Ind., secretary.

American Shorthorn Breeders' Association.—John W. Groves, Springfield, Ill., secretary.

American Sussex Association.—Overton Lea, Nashville, Tenn., secretary.

Ayrshire Breeders' Association.—C. M. Winslow, Brandon, Vt., secretary.

Brown Swiss Cattle Breeders' Association.—N. S. Fish, Groton, Conn., secretary.

Dutch Belted Cattle Association.—H. B. Richards, Easton, Pa., secretary.

Holstein-Friesian Association of America.—Frederick L. Houghton, Brattleboro, Vt., secretary.

Red Polled Cattle Club of America (incorporated).—J. McLain Smith, Dayton, Ohio, secretary.

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[1] Under the provisions of paragraph 473 of the act of July 24, 1897, any animal imported specially for breeding purposes shall be admitted free, provided that no such animal shall be admitted free unless pure bred, of a recognized breed, and duly registered in the book of record established for that breed. The Secretary of the Treasury, upon the advice of the Secretary of Agriculture, issued, June 22, 1899, regulations for the importation of animals under this law, and designated the recognized breeds and the books of record established for these breeds.

[2] Requirements for eligibility to registration can not be given fully in these lists of breeders' associations. Only the more general conditions are stated; for particulars application must be made to the secretary of the association.

Horses.

American Association of Importers and Breeders of Belgian Draft Horses.—J. D. Conner, jr., Wabash, Ind., secretary.

American Breeders' Association of Jacks and Jennets.—J. W. Jones, Columbia, Tenn., secretary.

American Cleveland Bay Breeders' Association.—R. P. Stericker, Attica, N. Y., secretary.

American Clydesdale Association.—R. B. Ogilvie, Chicago, Ill., secretary.

American Hackney Horse Society.—A. H. Godfrey, room 50, Astor Court Building, West Thirty-fourth street, New York City, secretary.

American Percheron Horse Breeders' Association.—S. D. Thompson, Chicago, Ill., secretary.

American Saddle Horse Breeders' Association.—I. B. Nall, Louisville, Ky., secretary.

American Shetland Pony Club.—Mortimer Levering, Lafayette, Ind., secretary.

American Shire Horse Breeders' Association.—Charles Burgess, Wenona, Ill., secretary.

American Stud Book, Thoroughbred.—James E. Wheeler, 173 Fifth avenue, New York, N. Y., registrar.

American Suffolk Punch Horse Association.—Alex. Galbraith, Janesville, Wis., secretary.

American Trotting Registry Association.—J. H. Steiner, room 1103, Ellsworth Building, 355 Dearborn street, Chicago, Ill., secretary.

French Coach Horse Society of America.—S. D. Thompson, Chicago, Ill., secretary.

German, Hanoverian, and Oldenburg Coach Horse Association of America.—J. Crouch, Lafayette, Ind., secretary.

National French Draft Association.—C. E. Stubbs, Fairfield, Iowa, secretary.

Select Clydesdale Horse Society of America.—E. Bennett, jr., Topeka, Kans., secretary.

The American Morgan Register.—Joseph Battell, Middlebury, Vt., treasurer.

The Oldenburg Coach Horse Association of America.—C. E. Stubbs, Fairfield, Iowa, secretary.

Sheep.

American Cheviot Sheep Society.—F. E. Dawley, Fayetteville, N. Y., secretary. Number of registrations, 11,901; date of first entry, March 24, 1894. Registration fees: To members, 50 cents for lambs under 1 year; over 1 year, $1; nonmembers, double. Affiliated foreign society: The Cheviot Sheep Society of Great Britain, John Robson, Newton, Bellingham, Northumberland, England, secretary. Eligible to registry: Animals whose sires and dams are recorded in the books of the National Cheviot Sheep Society, the American Cheviot Sheep Breeders' Association (this society), or the affiliated British book.

American Cotswold Association.—George Harding, Waukesha, Wis., secretary.

American Leicester Breeders' Association.—A. J. Temple, Cameron, Ill., secretary.

National Merino Sheep Register Association.—R. O. Logan, California, Mich., secretary.

American Oxford-Down Record Association.—W. A. Shafor, R. F. D. 1, Hamilton, Ohio, secretary.

American Southdown Association.—Frank S. Springer, Springfield, Ill., secretary.

American Shropshire Registry Association.—Mortimer Levering, Lafayette, Ind., secretary.

American Rambouillet Sheep Breeders' Association.—Dwight Lincoln, Milford Center, Ohio, secretary.

American Suffolk Association.—Geo. A. Franklin, Des Moines, Iowa, secretary.

Black Top Spanish Merino Sheep Breeders' Association.—R. P. Berry, R. F. D. 4, Washington, Pa., secretary.

Delaine Merino Sheep Breeders' Association.—J. C. McNary, Houstonville, Pa., recording secretary; J. H. Hamilton, Canonsburg, Pa., corresponding secretary.

Dickinson Merino Sheep Record Company.—H. G. McDowell, Canton, Ohio, secretary.

Dorset Horn Sheep Breeders' Association of America.—M. A. Cooper, Washington, Pa., secretary.

Hampshire-Down Breeders' Association of America.—Comfort A. Tyler, Nottawa, Mich., secretary.

Improved Black-top Merino Sheep Breeders' Association.—L. M. Crothers, Crothers, Pa., secretary.

Improved Delaine Merino Sheep Breeders' Association.—Geo. A. Henry, Bellefontaine, Ohio, secretary. Number of registrations, 14,500. Registration fees: 50 sheep, $5, and 100 sheep, $10, and 10 cents each additional. Eligible for registry: Animals of pure Spanish Merino blood that scale 85 points or more.

Michigan Merino Sheep Breeders' Association.—E. N. Ball, Hamburg, Mich., secretary.

National Improved Saxony Sheep Breeders' Association.—John G. Clarke, R. F. D. 9, Washington, Pa., secretary.

National Lincoln Sheep Breeders' Association.—H. A. Daniells, Millington, Mich., secretary.

New York State American Merino Sheep Breeders' Association.—J. H. Earll, Skaneateles, N. Y., secretary.

Ohio Spanish Merino Sheep Breeders' Association.—Wesley Bishop, Troyton, Ohio, secretary.

Standard Delaine Spanish Merino Sheep Breeders' Association.—S. M. Cleaver, East Bethlehem, Pa., secretary.

Standard American Merino Register Association.—J. P. Ray, Hemlock, N. Y., secretary.

The Continental Dorset Club.—J. E. Wing, Mechanicsburg, Ohio, secretary.

United States Merino Sheep Breeders' Registry Association.—J. A. B. Walker, Mountair, Pa., secretary.

Vermont, The, Atwood Merino Sheep Club Register.—George Hammond, Middlebury, Vt., secretary.

Vermont Merino Sheep Breeders' Association.—Ira L. Hamblin, Middlebury, Vt., secretary.

Hogs (Swine).

American Berkshire Association.—Charles F. Mills, 512 East Monroe street, Springfield, Ill., secretary.

American Duroc-Jersey Swine Breeders' Association.—A. V. Bradrick, Shelbyville, Ind., secretary.

American Essex Association.—F. M. Srout, McLean, Ill., secretary.

American Small Yorkshire Club.—G. W. Harris, 3409 Third avenue, New York, N. Y., secretary.

Cheshire Swine Breeders' Association.—B. B. Badger, Ouaquaga, N. Y., secretary.

Standard Chester White Record Association.—W. H. Morris, Indianapolis, Ind., secretary.

American Chester White Record Association.—Carl Freigau, Dayton, Ohio, secretary.

American Poland-China Record Company.—W. M. McFadden, West Liberty, Iowa, secretary.

Central Poland-China Record Association.—W. H. Morris, Indianapolis, Ind., secretary.

Ohio Poland-China Record Company.—Carl Freigau, Dayton, Ohio, secretary.

Standard Poland-China Record Association.—George F. Woodworth, Maryville, Mo., secretary.

Victoria Swine Breeders' Association.—H. Davis, Dyer, Ind., secretary.

Suffolk Swine Association.—W. F. Watson, Winchester, Ind., secretary.

National Duroc-Jersey Record Association.—R. J. Evans, El Paso, Ill., secretary.

The American Tamworth Swine Record Association.—E. N. Ball, Hamburg, Mich., secretary.

The American Yorkshire Club.—E. W. Wilcox, Hugo, Minn., secretary. Records Large Improved, Middle, and Small Yorkshires. Vol. I issued January 1, 1901. Number of registrations: Large Improved, males, 1,132; females, 1,230. Small, males, 237; females, 552. Middle, females, 1. Registration fees: To members, 50 cents; nonmembers, $1; animals over one year, double fees; transfers, 25 cents. Eligible to registry: All animals the direct offspring of animals eligible to record in recognized record; unrecorded ancestors must be recorded.

Goats, Hares, Dogs, etc.

American Kennel Club.—A. P. Vredenburgh, 55 Liberty street, New York, N. Y., secretary.

National Belgian Hare Club of America, Incorporated.—Roe E. Remington, Montclair, Colo., secretary.

The American Angora Goat Breeders' Association.—W. T. McIntire, 277 Live Stock Exchange, Kansas City, Mo.

POULTRY ASSOCIATIONS.

National and interstate organizations.

Name of organization.	Secretary.	Post-office.
American Dorking Club	F. H. Prentice	North Grafton, Mass.
American Buff Plymouth Rock Club	W. C. Denny	Rochester, N. Y.
American Black Minorca Club	John A. Gamewell	Hackensack, N. J.
American Cochin Club	Arthur R. Sharp	Taunton, Mass.
National Exhibition Game and Game Bantam Club	J. C. Pratt	170 Adams street, Chicago.
American Houdan Club	Thomas F. Rigg	Iowa Falls, Iowa.
American Leghorn Club	Geo. H. Burgott	Lawtons Station, N. Y.
American Plymouth Rock Club	H. P. Schwab	Rochester, N. Y.
American Indian Game Club	C. S. Whiting	Darien, N. Y.
Eastern White Wyandotte Club	W. E. Mack	Woodstock, Vt.
Minorca Club of Northwest	Dr. H. B. Fay	Minneapolis, Minn.
National Bantam Association	E. Latham	Flatbush, Long Island, N. Y.
New England Light Brahma Club	G. W. Cromack	Stoneham, Mass.
National Poultry and Pigeon Association	Geo. E. Howard	Washington, D. C.
National Fanciers' Association	Fred L. Kinney	Morgan Park, Ill.
Boston Poultry Association	C. Minot Weld	131 Devonshire street, Boston, Mass.
Wolverine P. P. and P. S. Association	Gus Williams	Bay City, Mich.
St. Louis Fanciers' Association	John A. Francisco	1201 Lincoln Tr. Bld., St. Louis, Mo.
Mid-Continental Poultry Association	F. M. Slutz	Kansas City, Mo.
Interstate Poultry Association	R. Horrocks	Falls City, Nebr.
Buffalo Poultry Association	E. C. Pease	Buffalo, N. Y.
Madison Square Garden (New York) Poultry and Pig Association.	H. V. Crawford	Montclair, N. J.
Northern Ohio Poultry and Pet Stock Association	F. R. Hunt	Cleveland, Ohio.
Buckeye Poultry Association	Geo. B. Wetzel	Dayton, Ohio.
Tri-State Poultry Association	J. A. McIntosh	East Liverpool, Ohio.
Pittsburg Fanciers' Club	A. P. Robinson	110 Second avenue Pittsburg, Pa.
Piedmont Poultry Association	B. W. Getsinger	Spartanburg, S. C.
Nashville Poultry Association	J. M. Hopkins	Nashville, Tenn.
Tacoma Poultry Association	C. C. Johns	402 Berlin Building, Tacoma, Wash.
Western Bantam Breeders' Association	A. E. Brown	Morgan Park, Ill.

Secretaries of State poultry associations.

State.	Secretary.	Post-office.
Colorado	Frank E. Kimball	Denver.
District of Columbia	Geo. E. Howard	Washington.
Illinois	Edward Craig	Albion.
Kansas	George H. Gillies	Topeka.
Kentucky	Charles Hess	Louisville.
Michigan	John A. Grover	Concord.
Missouri	Mrs. E. A. Creal	Carrollton.
Nebraska	L. W. Garoutte	Lincoln.
Oklahoma	L. F. Laverty	Guthrie.
Rhode Island	H. S. Babcock	Providence.
Tennessee	M. D. Andes	Bristol.
Utah	Geo. Laysum	129 W. First South street, Salt Lake City.
Vermont	J. S. Eaton	Woodstock.
West Virginia	H. D. Correll	Morgantown.

STATE ASSOCIATIONS OF BREEDERS.

Name of organization.	Secretary.	Post-office.
California Angora Goat Breeders' Association	C. E. Bailey	San Jose.
California Pacific Coast Jersey Cattle Club	A. Mailliard	San Geronimo.
California Jersey Breeders' Association of Southern California.	N. A. Chisholm	Santa Ana.
Colorado Cattle and Horse Growers' Association	C. W. Bowles	Littleton.
Connecticut Sheep Breeders' Association	John H. Wadhams	Goshen.
Illinois Live Stock Breeders' Association	Fred H. Rankin	Athens.
Illinois Horse Breeders' Association	George Williams	Do.
Illinois Cattle Breeders' Association	Samuel E. Prather	Springfield.
Illinois Cattle Feeders' Association	Charles F. Mills	Do.
Illinois Sheep Breeders' Association	Frank S. Springer	Do.
Illinois Swine Breeders' Association	Charles F. Mills	Do.
Illinois Seed Corn Breeders' Association	John R. Clisby	Arcola.
Kansas Improved Stock Breeders' Association	H. A. Heath	
Kentucky Swine Breeders' Association	M. W. Neal	Louisville.
Minnesota Grain Growers' Association	Dennis Fitzpatrick	Waverly.
Nebraska Improved Live Stock Breeders' Association	E. Z. Russell	Herman.
Nebraska Swine Breeders' Association	E. B. Trough	Minden.
Ohio Jersey Cattle Club	A. T. Dempsey	Columbus.
Ohio Short Horn Breeders' Association	S. B. Stewart	Canal Winchester.
Ohio Horse Breeders' Association	Samuel Taylor	Grove City.
Ohio Merino Sheep Breeders' Association	Wesley Bishop	Troyton.
Oregon Live Stock Breeders' Association	M. D. Wisdom	Portland.
Texas Live Stock Association	W. R. Spann	Dallas.
The American Tunis Sheep Breeders' Association	M. A. Bridges	Fincastle, Ind.
West Virginia Live Stock Association	C. C. Brown	Charleston.
West Virginia Sheep Breeders and Wool Growers' Association.	James Beall	Wellsburg.
Wisconsin Live Stock Breeders' Association.	Frank W. Harding	Waukesha.

STATE VETERINARIANS AND SECRETARIES OF SANITARY BOARDS.

ALABAMA:
- Dr. W. H. Sanders, Montgomery, State health officer.
- Dr. C. A. Cary, Auburn, professor of veterinary science.

ARIZONA:
- H. Harrison, Phoenix, secretary live-stock sanitary commission.
- Dr. J. C. Norton, Phoenix, veterinarian.

ARKANSAS:
- Dr. R. R. Dinwiddie, Fayette, veterinarian to State experiment station.

CALIFORNIA:
- Dr. W. P. Matthews, Sacramento, secretary State board of health.
- Dr. Charles H. Blemer, Sacramento, State veterinarian.

COLORADO:
- B. H. Du Bois, Denver, president State veterinary sanitary board.
- Dr. G. E. Tyler, State capitol, Denver, secretary State board of health.
- Dr. A. B. McCapes, Denver, State veterinary surgeon.
- E. McCrillis, Capitol building, Denver, secretary State board of stock inspection commissioners.

CONNECTICUT:
- Dr. C. A. Lindsley, New Haven, secretary State board of health.
- Herman O. Averill, Capitol, Hartford, commissioner for domestic animals.

DELAWARE:
- Dr. Alex Lowber, Wilmington, secretary State board of health.

GEORGIA:
- O. B. Stevens, Atlanta, commissioner of agriculture.

FLORIDA:
- Dr. Joseph Y. Porter, Key West, secretary State board of health.
- Dr. Chas. F. Dawson, Lake City, professor of veterinary science.

IDAHO:
- T. G. Lowe, Franklin, State sheep inspector.

ILLINOIS:
- Dr. J. A. Egan, Springfield, secretary State board of health.
- Dr. C. P. Lovejoy, Princeton, State veterinarian.
- H. F. Aspinwall, Springfield, secretary board of live-stock commissioners.

INDIANA:
- Dr. J. N. Hurty, Indianapolis, secretary State board of health.
- Dr. A. W. Bitting, Lafayette, State veterinarian.
- Mortimer Levering, Lafayette, secretary State live-stock sanitary commission.

IOWA:
Dr. J. I. Gibson, Denison, State veterinary surgeon.
Dr. J. F. Kennedy, Des Moines, secretary State board of health.

KANSAS:
Dr. W. B. Swan, Topeka, secretary State board of health.
M. C. Campbell, Wichita, secretary live-stock sanitary commission.
Dr. N. S. Mayo, Manhattan, professor of veterinary science.

KENTUCKY:
Dr. J. N. McCormack, Bowling Green, secretary State board of health.
Dr. F. T. Eisenman, Louisville, State veterinarian.

LOUISIANA:
Dr. Will R. Harman, New Orleans, secretary State board of health.
Dr. W. H. Dalrymple, Baton Rouge, veterinarian to State experiment station.

MAINE:
Dr. A. G. Young, Augusta, secretary State board of health.
Dr. George H. Bailey, Deering, State veterinarian.
F. O. Beal, Bangor, John M. Deering, Saco, and F. S. Adams, Bowdoinham, cattle commissioners.

MARYLAND:
Dr. John S. Fulton, 10 South street, Baltimore, secretary State board of health.
Dr. H. A. Meisner, Merchants' Nat. Bank, Baltimore, chief veterinary inspector.

MASSACHUSETTS:
Dr. Samuel W. Abbott, Boston, secretary State board of health.
Dr. Austin Peters, Boston, chairman board of cattle commissioners.

MICHIGAN:
Dr. Henry B. Baker, Lansing, secretary State board of health.
Dr. F. C. Wells, Warren, State veterinarian.
H. H. Hinds, Stanton, president State live-stock sanitary commission.

MINNESOTA:
Dr. S. D. Brimhall, St. Paul, director veterinary department of State board of health.
Dr. H. M. Bracken, St. Paul (Pioneer Press Building), secretary State board of health.

MISSISSIPPI:
Dr. John F. Hunter, Jackson, secretary State board of health.
Dr. J. C. Robert, Agricultural College, professor of veterinary science.

MISSOURI:
Dr. Willis P. King, Kansas City (Fountain place), secretary State board of health.
Dr. D. F. Luckey, Columbia, State veterinarian.
Geo. B. Ellis, Columbia, secretary State board of agriculture.

MONTANA:
Dr. M. E. Knowles, Helena, State veterinarian.

NEBRASKA:
H. R. Corbet, Lincoln, secretary State board of health.
Dr. W. A. Thomas, Lincoln, State veterinarian.

NEVADA:
Dr. W. H. Patterson, Reno, secretary State board of health.

NEW HAMPSHIRE:
Dr. Irving A. Watson, Concord, secretary State board of health.
N. J. Bachelder, Concord, secretary board of cattle commissioners.

NEW JERSEY:
Dr. Henry Mitchell, Trenton, secretary State board of health.
Frank Dye, Trenton, secretary tuberculosis commission.

NEW MEXICO:
Dr. J. M. Cunningham, East Las Vegas, secretary State board of health.
J. H. La Rue, East Las Vegas, secretary cattle sanitary board.
Harry F. Lee, Albuquerque, secretary sheep sanitary board.

NEW YORK:
Dr. Baxter T. Smelzer, Albany, secretary board of health.
Dr. Wm. H. Kelly, Albany, consulting State veterinarian.

NORTH CAROLINA:
Dr. Richard H. Lewis, Raleigh, secretary board of health.
Dr. Tait Butler, Raleigh, State veterinarian.
S. L. Patterson, commissioner of agriculture.

NORTH DAKOTA:
Dr. J. W. Dunham, Fargo, chief State veterinarian.
Dr. John Montgomery, Ardoch, secretary board of health.

OHIO:
Dr. C. O. Probst, Columbus, secretary board of health.
Dr. H. M. W. Moore, Columbus, secretary live-stock commission.

OKLAHOMA:
- Dr. C. D. Arnold, Kingfisher, superintendent board of health.
- Z. E Beemblossom, Guthrie, secretary live-stock sanitary commission.

OREGON:
- Dr. William McLean, Portland, State veterinarian.

PENNSYLVANIA:
- Dr. Benjamin Lee, 1532 Pine street, Philadelphia, secretary State board of health.
- Dr. Leonard Pearson, 3608 Pine street, Philadelphia, State veterinarian.

RHODE ISLAND:
- Dr. Gardner T. Swarts, Providence, secretary State board of health.
- John S. Pollard, veterinarian State board of agriculture.

SOUTH CAROLINA:
- Dr. James Evans, Florence, secretary board of health.
- Dr. G. E. Nesom, Clemson College, State veterinarian.

SOUTH DAKOTA:
- J. L. Harris, Webster, secretary board of health.
- Dr. J. P. Foster, Selby, State veterinarian.

TENNESSEE:
- Dr. J. A. Albright, Somerville, secretary State board of health.
- W. H. Dunn, live-stock commissioner, Nashville.
- Dr. J. W. Sheibler, Memphis, State veterinarian.

TEXAS:
- Dr. R. M. Swearingen, Austin, State health officer.
- Robert J. Kleberg, Corpus Christi, secretary live-stock sanitary commission.

UTAH:
- Dr. T. B. Beatty, Salt Lake City, secretary State board of health.

VERMONT:
- H. D. Holton, Brattleboro, secretary board of health.
- C. J. Bell, East Hardwick, secretary cattle commission.

VIRGINIA:
- Dr. Paulus A. Irving, Richmond, secretary board of health.
- Dr. E. P. Niles, Blacksburg, State veterinarian.

WASHINGTON:
- Dr. Elmer H. Heg, North Yakima, secretary board of health.
- Dr. S. B. Nelson, Pullman, State veterinarian experiment station.

WEST VIRGINIA:
- Dr. A. R. Barbee, Point Pleasant, secretary State board of health.
- J. B. Garvin, Charleston, secretary board of agriculture.

WISCONSIN:
- Dr. Evan D. Roberts, Janesville, State veterinarian.
- Dr. U. O. B. Wingate, Milwaukee, secretary board of health.

WYOMING:
- Dr. George T. Seabury, Cheyenne, State veterinarian.
- George East, president, board of live-stock commissioners.

STATES HAVING OFFICES FOR FOREST WORK.

CONNECTICUT.—State forester, Walter L. Mulford, New Haven.

INDIANA.—State board of forestry, Albert Lieber, president, Indianapolis.

KANSAS.—Forestry commissioner, R. M. Wright, Dodge City.

MAINE.—Land agent and forest commissioner, Edgar E. Ring, Augusta.

MARYLAND.—State geologic and economic survey, Wm. B. Clark, State geologist.

MICHIGAN.—Forestry commission, Charles W. Garfield, president, Grand Rapids.

MINNESOTA.—Fire warden, Gen. C. C. Andrews, St. Paul.
Forest commissioner, R. C. Dunn, St. Paul.
State forestry board, Sidney M. Owen, president, Minneapolis; Gen. C. C. Andrews, secretary, St. Paul.

NEW HAMPSHIRE.—Forest commission, George H. Moses, secretary, Concord.

NEW JERSEY.—Geological survey, Henry B. Kümmel, State geologist, Trenton.

NEW YORK.—Forest, fish, and game commission, Lieut. Gov. Timothy L. Woodruff, chairman.
Superintendent of State forests.—William F. Fox, Albany.

NORTH CAROLINA.—Geological survey, Prof. J. A. Holmes, State geologist, Chapelhill.

NORTH DAKOTA.—State superintendent of irrigation and forestry, W. W. Barrett, Bismarck.

OREGON.—Game and forestry warden, L. P. W. Quimby, Portland.

PENNSYLVANIA.—Department of forestry, Dr. J. T. Rothrock, commissioner, Harrisburg.
State forestry reservation commission, Isaac B. Brown, secretary.

West Virginia.—Geologic and economic survey, Dr. I. C. White, superintendent, Morgantown.
Wisconsin.—State forest warden, C. E. Morley, Madison.

FORESTRY ASSOCIATIONS.

National Organizations.

American Forestry Association.—President, Hon. James Wilson, Secretary of Agriculture; secretary (corresponding), F. H. Newell, United States Geological Survey, Washington, D. C.

International Society of Arboriculture.—President, J. Sterling Morton,[1] Nebraska City, Nebr.; secretary, J. P. Brown, Connersville, Ind.

Society of American Foresters.—President, Gifford Pinchot, Washington, D. C.; secretary, Geo. B. Sudworth. Washington, D. C.

State Organizations.

Name of organization.	Secretary.	Post-office.
California Water and Forest Association	T. C. Friedlander	San Francisco.
(California) Sierra Club	W. R. Dudley	Stanford University.
Forest and Water Society of Southern California	William H. Knight	Los Angeles.
Salt River Valley (California) Water Supply Protective Association.	H. M. Chapman	
Colorado Forestry Association	D. W. Working	Denver.
Connecticut Forestry Association	Miss Mary Winslow	Weatogue.
Massachusetts Forestry Association	Edwin A. Start	Medford.
Michigan Forest, Game, and Fish Protective Association	E. P. Alden	Saginaw East.
Minnesota State Forestry Association	George W. Strand	Taylors Falls.
Nebraska Forestry Association	E. T. Hartley	Lincoln.
Society for the Protection of New Hampshire Forests.	J. T. Walker	Concord.
New York State Fish, Game, and Forest League	E. G. Gould	Seneca Falls.
(New York) Association for the Protection of the Adirondacks.	Henry S. Harper	Tribune Building, New York.
North Carolina Forestry Association	W. W. Ashe	Chapelhill.
North Dakota State Sylvaton Society,	Miss Mary G. Buck	Lakota.
Oregon Forestry Association	Martin W. Gorman	Portland.
Mazamas, The	Albert J. Capron	Portland, Oreg.
Pennsylvania Forestry Association	Mrs. John P. Lundy	215 South Eighteenth street, Philadelphia.
Franklin Forestry Society	W. G. Bowers	Chambersburg, Pa.
Utah Forestry Association	A. C. Nelson	Salt Lake City.
Washington Forestry Association	Albert Bryan	

SCHOOLS OF FORESTRY.

Yale Forest School, New Haven: A two-years graduate course in connection with the Yale Forest School, a two-months summer course, July and August, is conducted at Milford, Pa. Prof. Henry S. Graves, Director.

New York State College of Forestry at Cornell University, Ithaca: Four-years course; practical instruction afforded by a demonstration area of 30,000 acres of State forest. Dr. B. E. Fernow, Director.

Baltimore School of Forestry, Baltimore: One-year course, comprising practical work in the forest, theoretical instruction, and forest research. No botany or other auxiliary sciences. Dr. C. A. Schenck, Director.

OFFICERS AND MEMBERS OF STATE BOARDS OF HORTICULTURE.

California State Board of Horticulture, 1902.—President, Ellwood Cooper, Santa Barbara; vice-president, Frank H. Buck, Vacaville; secretary and chief horticultural officer, T. T. Keegan, Sacramento; treasurer, H. Weinstock, Sacramento; auditor, R. D. Stephens, Sacramento; quarantine officer and entomologist, Alexander Craw, Sacramento; district commissioners, M. J. Daniel, Riverside; W. J. Hotchkiss, Healdsburg; A. C. Eisen, Fresno; A. B. Cash, Santa Clara; Thos. A. Hender, Sonora.

Colorado State Board of Horticulture, 1902.—President, W. S. Coburn, Hotchkiss; secretary, Mrs. M. A. Shute, Denver; members, J. H. Crowley, Rockyford; David Brothers, Denver; J. R. Penniston, Whitewater.

Indiana State Board of Horticulture, 1902.—President, W. W. Stevens, Salem; vice-presidents, E. M. C. Hobbs, W. C. Reed, E. B. Davis, and J. C. Grossman; secretary, W. B. Flick, Lawrence; treasurer, Silvester Johnson, Irvington; executive committee, J. Troop, L. B. Custer, Joe A. Burton.

[1] Died April 27, 1902.

Montana State Board of Horticulture, 1902.—President, S. M. Emery, Manhattan; secretary, C. H. Edwards, Butte; district committeemen, S. M. Emery, C. H. Campbell, C. M. Allen, J. H. Edwards; ex officio, Governor Joseph K. Toole, Helena.

Oregon State Board of Horticulture, 1902.—President, E. L. Smith, Hood River; secretary, Henry E. Dosch; treasurer, Lloyd T. Reynolds; commissioners, Wilbur K. Newell, Lloyd T. Reynolds, A. H. Carson, and Judd Geer.

Utah State Board of Horticulture, 1902.—President, Thomas Judd; vice-president, B. H. Bower; secretary, J. A. Wright, Ogden.

SECRETARIES OF HORTICULTURAL AND KINDRED SOCIETIES.

Name of organization.	Secretary.	Post-office.
American Association of Nurserymen	George C. Seager	Rochester, N. Y.
American Carnation Society	Albert M. Herr.	Lancaster, Pa.
American Cranberry Growers' Association	A. J. Rider	3143 Mantua avenue, Philadelphia, Pa.
American Fruit Growers' Association	John C. Mangan	Bridge, Minn.
American Pomological Society	William A. Taylor	55 Q street NE., Washington, D. C.
American Rose Society	Leonard Barron	136 Liberty street, New York, N. Y.
Chrysanthemum Society of America	Edwin Lonsdale	Wyndmoor, Chestnut Hill, Pa.
Cider and Cider-Vinegar Association of the Northwest.	George Miltenberger	213 North Second street, St. Louis, Mo.
Eastern Nurserymen's Association	William Pitkin	Rochester, N. Y.
Farmers' Club of American Institute, Horticultural Section.	Leonard Barron	136 Liberty street, New York City.
Mississippi Valley Apple Growers' Association	James Handly	Quincy, Ill.
Missouri Valley Horticultural Society	C. A. Chandler	Argentine, Kans.
National Apple Shippers' Association	Warren Patch	17 N. Market street, Boston, Mass.
Northwest Fruit Growers' Association	C. F. Van De Water	Walla Walla, Wash.
Peninsula Horticultural Society	Wesley Webb	Dover, Del.
Society of American Florists and Ornamental Horticulturists	William J. Stewart	79 Milk street, Boston, Mass.
Southern Nurserymen's Association	W. Lee Wilson	Winchester, Tenn.
Western Association of Wholesale Nurserymen	E. J. Holman	Leavenworth, Kans.
Arkansas State Horticultural Society	Ernest Walker	Fayetteville.
California State Floral Society	Mrs. H. P. Tricou	814 Grove street, San Francisco.
Colorado State Horticultural Society	Charles Parsons	Boulder.
Connecticut Pomological Society	H. C. C. Miles	Milford.
Connecticut Horticultural Society	L. H. Mead	Hartford.
Florida State Horticultural Society	Stephen Powers	Jacksonville.
Georgia Horticultural Society	L. A. Berckmans	Augusta.
Idaho State Horticultural Society	Robert Milliken	Nampa.
Illinois State Horticultural Society	L. R. Bryant	Princeton.
Indiana Horticultural Society	W. B. Flick	Lawrence.
Iowa State Horticultural Society	Wesley Greene	Des Moines.
Kansas State Horticultural Society	William H. Barnes	Topeka.
Kentucky State Horticultural Society	J. C. Hawes	Ferncreek.
Maine Pomological Society	D. H. Knowlton	Farmington.
Maryland State Horticultural Society	A. L. Quaintance	Collegepark.
Massachusetts Fruit Growers' Association	C. A. Whitney	Upton.
Massachusetts Horticultural Society	N. T. Kidder	300 Mass. avenue, Boston.
Michigan State Horticultural Society	C. E. Bassett	Fennville.
Minnesota State Horticultural Society	A. W. Latham	207 Kasota Block, Minneapolis.
Missouri State Horticultural Society	L. A. Goodman	4000 Warwick Boulevard, Kansas City.
Montana State Horticultural Society	Mrs. Emma Ingalls	Kalispell.
Nebraska State Horticultural Society	C. H. Barnard	Tablerock.
New Hampshire State Horticultural Society	W. D. Baker	Quincy.
New Jersey State Horticultural Society	Henry I. Budd	Mount Holly.
New Mexico State Horticultural Society	Jose D. Sena	Santa Fe.
New York State Fruit Growers' Association	F. E. Dawley	Fayetteville.
(New York) Horticultural Society of New York	Leonard Barron	136 Liberty street, New York.
North Carolina State Horticultural Society	Franklin Sherman	Agricultural Department, Raleigh.
Ohio State Horticultural Society	W. W. Farnsworth	Waterville.
Oklahoma Horticultural Society	J. B. Thoburn	Oklahoma City.
Oregon State Horticultural Society	E. R. Lake	Corvallis.
Pennsylvania Horticultural Society	David Rust	Horticultural Hall, Philadelphia.
Pennsylvania State Horticultural Association	W. P. Brinton	Christiana.
Rhode Island Horticultural Society	Charles W. Smith	27 Exchange street, Providence.
South Carolina State Horticultural Society	Charles E. Chambliss	Clemson College.
South Dakota State Horticultural Society	N. E. Hansen	Brookings.
Texas State Horticultural Society	Sam H. Dixon	Houston.

SECRETARIES HORTICULTURAL AND KINDRED SOCIETIES—Cont'd.

Name of organization.	Secretary.	Post-office.
Vermont Horticultural Society	D. C. Hicks	North Clarendon.
Virginia State Horticultural Society	Walter Whately	Crozet.
West Virginia State Horticultural Society	K. C. Davis	Morgantown.
Wisconsin State Horticultural Society	J. L. Herbst	Sparta.
Wisconsin State Cranberry Growers' Association	W. H. Fitch	Cranmoor.

BEE KEEPERS' ASSOCIATIONS.

Name of organization.	Secretary.	Post-office.
National Bee Keepers' Association	A. B. Mason	Toledo, Ohio.
California State Bee Keepers' Association	J. F. McIntyre	Sespe.
The California Bee Keepers' Association	Prof. C. S. Taylor	Selma.
Colorado Honey Producers' Association	Frank Rauchfuss	Denver.
Colorado State Bee Keepers' Association	D. W. Working	Do.
Connecticut Bee Keepers' Association	Miss Ellen B. Peck	Clinton.
Idaho State Bee Keepers' Association	Miss D. M. Patterson	Lower Boise.
Illinois State Bee Keepers' Association	James A. Stone	R. F. D. 4, Springfield.
Indiana State Bee Keepers' Association	W. S. Pouder	Indianapolis.
Eastern Iowa Bee Keepers' Association	W. A. Hay	Anamosa.
Southeastern Kansas Bee Keepers' Association	J. C. Balch	Bronson.
Michigan State Bee Keepers' Association	Jas. A. Dart	Petoskey.
Minnesota Bee Keepers' Association	L. D. Leonard	Minneapolis.
Nebraska Bee Keepers' Association	L. D. Stilson	York.
New Jersey Bee Keepers' Association	George N. Wanser	Cranford.
New York State Association of Bee Keepers' Societies.	C. B. Howard	Romulus.
New York State Bee Keepers' Association	J. H. Knickerbocker	Pleasant Valley.
Northeastern Ohio and Northwestern Pennsylvania Bee Keepers' Association.	Ed. Jolley	Franklin, Pa.
South Dakota State Bee Keepers' Association		
Southern East Tennessee Bee Keepers' Association	W. J. Copeland	Fetzerton.
Texas State Bee Keepers' Association	J. N. Hunter	Wylie.
Utah Bee Keepers' Association	J. B. Fagg	Millcreek.
Vermont Bee Keepers' Association	M. F. Cram	West Brookfield.
Washington State Bee Keepers' Association	L. R. Freeman	North Yakima.
Wisconsin State Bee Keepers' Association	Miss Ada L. Pickard	Richland Center.

THE NATIONAL GOOD ROADS ASSOCIATION.

President, W. H. Moore; secretary, R. W. Richardson; treasurer, Edwin A. Potter. Address for general officers, 928–29, Marquette Building, Chicago, Ill.

Vice-presidents of association.

State.	Vice-president.	Post-offic
Alabama	W. M. Drennen	Birmingham.
California	J. Baruch	Los Angeles.
Colorado	W. H. Wadley	Denver.
Florida	A. S. Mann	Jacksonville.
Georgia	Clifford L. Anderson	Atlanta.
Illinois	Gus M. Greenebaum	Danville.
Iowa	G. H. Van Houten	Des Moines.
Idaho	W. E. Pierce	Boise.
Kansas	Wm. Bradbury	Topeka.
Kentucky	I. B. Nall	Frankfort.
Maryland	Wm. D. Clark	Johns Hopkins, Baltimore.
Michigan	A. E. Palmer	Kalkaska.
Minnesota	Geo. W. Cooley	Minneapolis.
Montana	Samuel Fortier	
Mississippi	John A. Redhead	Centerville.
Missouri	H. R. Whitmore	St. Louis.
Nebraska	G. R. Williams	Elk City.
New Jersey	Henry I. Budd	Trenton.
New York	John B. Weber	Buffalo.
North Carolina	J. A. Holmes	Chapelhill.
Ohio	J. W. Stewart	Cleveland.
South Carolina	E. S. Tessier, jr	Charleston.
Tennessee	S. D. Hays	Jackson.
Virginia	H. W. Anderson	Richmond.
Washington	J. A. James	Seattle.
Wisconsin	G. N. Fratt	Racine.

THE PROTECTION OF BIRDS AND GAME.

State and Provincial (Canadian) officials.

States, Territories, and Provinces.	Commissioners.	Post-office.
Arizona	T. S. Bunch	Safford.
California	Chas. A. Vogelsang, chief deputy.	Mills Building, San Francisco.
Colorado	Charles W. Harris	Denver.
Connecticut	E. Hart Geer, secretary	Hadlyme.
Idaho	T. W. Bartley, warden	Moscow.
Illinois	A. J. Lovejoy	Roscoe.
Indiana	Z. T. Sweeney	Columbus.
Iowa	G. A. Lincoln, warden	Cedar Rapids.
Maine	L. T. Carleton, chmn	Augusta.
Maryland	Jno. W. Avirett, warden	Cumberland.
	Robt. H. Gilbert, chf. dep. warden.	Calvert and Lombard streets, Baltimore.
Massachusetts	Joseph W. Collins, chmn	Boston.
Michigan	Grant M. Morse, warden	Portland.
Minnesota	S. F. Fullerton, ex. agt	St. Paul.
Missouri	A. J. D. Burford	Burfordville.
Montana	William F. Scott, warden	Helena.
Nebraska	Geo. B. Simpkins, chief deputy.	Lincoln.
New Hampshire	Chas. B. Clarke, secretary	Concord.
New Jersey	Howard P. Frothingham, president.	Pompton Lakes.
New York	J. Warren Pond, chief game protector.	Albany.
North Dakota	Ever Wagness, warden	Devils Lake.
Ohio	L. H. Reutinger, sec	Columbus.
Oklahoma	C. M. Keiger, warden	Jefferson.
Oregon	L. P. W. Quimby, warden	Portland.
Pennsylvania	Dr. Joseph Kalbfus, sec	Harrisburg.
Rhode Island	Dr. F. H. Peckham, jr., chmn	Providence.
Utah	John Sharp	Salt Lake City.
Vermont	Henry G. Thomas	Stowe.
Washington	T. R. Kershaw, warden	Tacoma.
West Virginia	E. F. Smith, warden	Hinton.
Wisconsin	Henry Overbeck, jr., warden	Madison.
Wyoming	D. C. Nowlin, warden	Big Piney.
British Columbia	F. S. Hussey, supt	Victoria.
Manitoba	C. Barber, warden	Winnipeg.
New Brunswick	L. B. Knight	St. John.
Newfoundland	E. C. Watson, dep. minister.	St. Johns.
Nova Scotia	George Piers, secretary	Halifax.
Ontario	Wm. Montagu Smith, chmn	Strathroy
Quebec	S. N. Parent, minister	Quebec.

National organizations.

Name of organization.	Secretary.	Post-office.
American Ornithologists' Union—Committee on Protection of North American Birds.	William Dutcher, chmn	525 Manhattan avenue, New York, N. Y.
Bird Protective Society of America	Edward C. Pease	28 Stafford Building, Buffalo, N. Y.
Boone and Crockett Club	C. Grant La Farge	5 Beekman street, New York, N. Y.
International Forest, Fish, and Game Association.	Frank J. Howell	184 Linden Park boulevard, Chicago, Ill.
League of American Sportsmen	Arthur F. Rice	155 Pennington avenue, Passaic, N. J.
National Game, Bird, and Fish Protective Association.	Charles E. Brewster	Grand Rapids, Mich.
National Sportsmen's Association	J. A. H. Dressel	320 Broadway, New York, N. Y.
North American Fish and Game Protective Association.	E. T. D. Chambers	Quebec.

Chief wardens of League of American Sportsmen.

States, Territories, and Provinces.	Chief warden.	Post-office.
Arizona	M. J. Foley	Jerome.
Arkansas	W. R. Blockson	Mena.
California	Dr. David Starr Jordan	Stanford University.
Colorado	A. Whitehead	303 Tabor Building, Denver.
Connecticut	F. P. Sherwood	Southport.
District of Columbia	Chas. H. Townsend	U. S. Fish Commission, Washington.
Florida	Frank Clarkson	Jacksonville.
Georgia	J. J. Doughty	Augusta.
Idaho	T. W. Bartley	Moscow.
Illinois	W. T. Jefferson	Plymouth Building, Chicago.
Indiana	F. L. Littleton	30½ East Washington street, Indianapolis.
Iowa	Carl Quimby	Des Moines.
Kansas	C. E. Sawyer	Wichita.
Kentucky	Geo. C. Long	Hopkinsville.
Maine	Col. E. C. Farrington	Augusta.
Massachusetts	Heman S. Fay	Hazleton Block, Marlboro.
Michigan	J. Elmer Pratt	341 South College avenue, Grand Rapids.
Minnesota	Dietrich Lange	937 York street, St. Paul.
Missouri	Bryan Snyder	726 Central Building, St. Louis.
Montana	Prof. M. J. Elrod	Missoula.
Nebraska	Fred E. Mockett	Lincoln.
Nevada	Dr. W. H. Cavell	Carson City.
New Hampshire	C. M. Brooks	105 West street, Keene.
New Jersey	A. W. Van Saun	Pompton Plains.
New Mexico	W. P. Sanders	Magdalena.
New York		
North Dakota	Dr. W. D. Jones	Devils Lake.
Ohio	L. H. Reutinger	Columbus.
Oklahoma	W. M. Grant	Oklahoma City.
Oregon	Robert F. Kelly	Box 188, The Dalles.
Pennsylvania	C. F. Emerson	189 North Perry street, Titusville.
Rhode Island	Zenas W. Bliss	49 Westminster street, Providence.
South Dakota	Burdett Moody	Lead.
Tennessee	Austin Peay, jr., sec	Clarksville.
Texas	Prof. S. W. Stanfield	San Marcos.
Utah	John Sharp	Salt Lake City.
Vermont	W. E. Mack	Woodstock.
Virginia	Franklin Stearns	13 North Eleventh street, Richmond.
Washington	F. S. Merrill	Spokane.
West Virginia	J. M. Lashley	Davis.
Wisconsin	James T. Drought	Milwaukee.
Wyoming	H. E. Wadsworth	Lander.
Ontario	C. A. Hammond	Box 701, St. Thomas.

State organizations.

Name of organization.	Secretary.	Post-office.
Arizona Sportsmen's Association	M. E. Cunningham	Bisbee.
Arkansas State Sportsmen's Association	Paul R. Litzke	Little Rock.
California Game and Fish Protective Association.	W. W. Richards	208 Golden Gate avenue, San Francisco.
[California] Cooper Ornithological Club	C. Barlow	Santa Clara.
Connecticut Association for the Protection of Fish and Game.	George P. McLean	Simsbury.
Delaware Game Protective Association	J. Danforth Bush	Wilmington.
Game and Fish Protective Association of the District of Columbia.	Dr. W. P. Young	419 Tenth street NW., Washington.
Illinois Fish and Game Protective Association.	H. A. Sullivan	1510 Ashland Block, Chicago.
Illinois State Sportsmen's Association	Ed. Bingham	Chicago.
Iowa State Sportsmen's Association	L. D. Crissman	Ottumwa.
Kentucky Field Trials Club	Dr. F. W. Samuel	Louisville.
Kentucky Fish and Game Club	Hamilton Griswold	139 Third street, Louisville.
Maine Ornithological Society	Arthur H. Norton	Westbrook.
Maine Sportsmen's Fish and Game Association.	Col. E. C. Farrington	Augusta.
Maryland State Game and Fish Protective Association.	Oregon Milton Dennis	23 Chamber of Commerce, Baltimore.

State organizations—Continued.

	Secretary.	Post-office.
Massachusetts Central Committee for the Protection of Fish and Game.	Henry H. Kimball	68 Devonshire street, Boston.
Mass. Fish and Game Protective Association.	Henry H. Kimball	Do.
Rod and Gun Club of Massachusetts	W. C. Thairlwall	95 South street, Boston.
Massachusetts Sportsmen's Association	Francis B. Crowinshield	Boston.
Michigan State Game and Fish Protective League.	R. S. Woodliff	Jackson.
Minnesota Game and Fish Protective Ass'n.	Wm. L. Tucker	Duluth.
Minn. Hunters' and Anglers' Protective Ass'n	C. S. Brown	Minneapolis.
Missouri State Game and Fish Protective Association.	Herbert Taylor	1005 Chemical Building, St. Louis.
Montana Fish and Game Protective Association.	A. L. Palmer	Helena.
Nebraska Ornithologists' Union	Robert H. Wolcott	Lincoln.
New York Association for the Protection of Game.	Robert B. Lawrence	35 Wall street, New York.
New York State Fish, Game, and Forest League.	Ernest G. Gould	Seneca Falls.
North Dakota State Sportsmen's Association.	G. E. Carpenter	Fargo.
[Ohio] Cuvier Club of Cincinnati	William J. Lawler	1380 Myrtle avenue, Cincinnati.
Ohio Fish and Game Protective Association.	J. C. Porterfield	Columbus.
Ohio Sportsmen's Protective Association	C. T. Bodifield	24 South Water street, Cleveland.
Oregon Fish and Game Association	A. E. Gebhardt	Portland.
[Oregon] John Burroughs Bird Society	Clarence H. Gilbert, pres.	1346 Yamhill st., Portland.
Pennsylvania State Sportsmen's Association	J. M. Runk	Chambersburg.
[Pennsylvania] Delaware Valley Ornithological Club.	Wm. B. Evans	252 South Front street, Philadelphia.
[South Carolina] Western Carolina Game Protection Association.	Charles F. Schwing	Greenville.
Texas Game Protective Association	Turner E. Hubby	Waco.
Texas State Sportsmen's Association	V. C. Dargen	Dallas.
Utah State Fish and Game Protective Ass'n.	George D. Alder	Salt Lake City.
Vermont Bird Club	Geo. H. Ross	Rutland.
Vermont Fish and Game League	E. T. Bradley	Swanton.
Eastern Shore Game Protective Association of Virginia.	T. W. Blackstone	Accomac.
W. Virginia State Sportsmen's Association.	Ed. O. Bower	Sistersville.
Wisconsin Game Protective Association	August Plambeck	Milwaukee.
Province of Quebec Association for the Protection of Fish and Game.	William J. Cleghorn	4460 Sherbrooke street, Montreal.
Sportsmen's Fish and Game Protective Association of the Province of Quebec.	E. T. D. Chambers	Quebec.

Audubon societies.

Name of organization.	Secretary.	Post-office.
California	Mrs. George S. Gay	Redlands.
Connecticut	Mrs. William Brown Glover.	Fairfield.
Delaware	Mrs. W. S. Hilles	904 Market street, Wilmington.
District of Columbia	Mrs. John Dewhurst Patten.	2212 R street, Washington.
Florida	Mrs. I. Vanderpool	Maitland.
Illinois	Miss Mary Drummond	208 West street, Wheaton.
Indiana	William Watson Woollen	Commercial Club, Indianapolis.
Iowa	Mrs. Lillian E. Felt	524 Concert street, Keokuk.
[Iowa] Schaller Audubon Society	Miss J. E. Hamand	Schaller.
Kentucky	Ingram Crockett	Henderson.
Maryland	Miss Anne Weston Whitney	715 St. Paul street, Baltimore.
Massachusetts	Miss Harriet E. Richards	Society of Natural History, Boston.
Minnesota	Miss Sarah L. Putnam	125 Inglehart street, St. Paul.
[Minnesota] Lake City Audubon Society	Mrs. C. A. Koch	Lake City.
Missouri	August Reese	2516 North 14th street, St. Louis
New Hampshire	Mrs. F. W. Batchelder	Manchester.
New Jersey	Miss Julia S. Scribner	510 East Front street, Plainfield.
New York	Miss Emma H. Lockwood	243 West Seventy-fifth street, New York.
North Carolina	Miss Annie F. Petty	Greensboro.
Ohio	Mrs. D. Z. McClelland	5265 Eastern avenue Cincinnati.
Pennsylvania	Mrs. Edward Robins	114 South Twenty-first street, Philadelphia, Pa.
Rhode Island	Miss Harriet C. Richards	Providence.

Audubon societies—Continued.

Name of organization.	Secretary.	Post-office.
South Carolina	Miss S. A. Smyth	35 Legare street, Charleston.
Tennessee	Mrs. C. C. Conner	Ripley.
Vermont	Mrs. Fletcher K. Barrows	Brattleboro.
Virginia	Mrs. Frederick E. Town	Glencarlyn.
West Virginia	Mrs. Edward Robins	114 South Twenty-first street, Philadelphia.
Wisconsin	Mrs. Reuben G. Thwaites	260 Langdon street, Madison.
Wyoming	Mrs. N. R. Davis	2116 Ferguson street, Cheyenne.

NATIONAL LIVE STOCK ASSOCIATION.

President, John W. Springer, Denver; secretary, Charles F. Martin, Denver.

AMERICAN RICE ASSOCIATION.

President, S. A. Knapp, Lake Charles, La.; secretary, Alex. B. Allison, Crowley, La.

INTERSTATE COTTON GROWERS' PROTECTIVE ASSOCIATION.

President, Harvie Jordan, Monticello, Ga.

ALLIED NATIONAL AGRICULTURAL SOCIETIES OF AMERICA.

President, J. C. Hanley, 400 Baltimore Block, St. Paul, Minn.

AFFILIATED SOCIETIES.

American Live Stock Raisers' Association; secretary, T. S. Russell, Chamber of Commerce Building, St. Paul, Minn.

Farmers' Federation of the Mississippi Valley; secretary, James Butler, Topeka, Kans.

National Seed Growers' Association; secretary, S. F. Willard, Weathersfield, Conn.

National Farmers' League of America; secretary, J. S. McDonald, Rush City, Minn.

National Grain Growers' Cooperative Association; secretary, J. C. Hanley, 400 Baltimore Block, St. Paul, Minn.

FARMERS' NATIONAL CONGRESS.

President, Geo. L. Flanders, Albany, N. Y.; first vice-president, Harvie Jordan, Monticello, Ga.; second vice-president, B. Cameron, Stagville, N. C.; secretary, John M. Stahl, No. 4328 Langley avenue, Chicago, Ill.; assistant secretaries, Edward A. Callahan, Albany, N. Y., Geo. M. Whitaker, Boston, Mass., and Joel M. Roberts, Waco, Nebr.; treasurer, J. H. Reynolds, Adrian, Mich.; executive committee, B. F. Clayton, Indianola, Iowa, E. W. Wicke, Ocean Springs, Miss., W. L. Ames, Oregon, Wis., with president and secretary, ex officio.

PATRONS OF HUSBANDRY.

NATIONAL OFFICERS.

Master, Aaron Jones, South Bend, Ind.; overseer, O. Gardner, Rockland, Me.; lecturer, N. J. Bachelder, Concord, N. H.; treasurer, Mrs. E. S. McDowell, Columbus, Ohio; secretary, John Trimble, No. 514 F street, NW., Washington, D. C.; executive committee, E. B. Norris, Sodus, N. Y.; C. J. Bell, East Hardwick, Vt.; J. J. Woodman, Paw Paw, Mich.; Aaron Jones, ex officio, South Bend, Ind.

OFFICERS OF

List of masters and other officers for

State.	Master.	Post-office.	Lecturer.	Post-office.
Alabama	H. Hawkins	Hawkinsville	Rev. A. Daugherty	Dothen
California	C. W. Emery	1194 E. Fifteenth street, Oakland.	J. D. Cornell	911 L street, Sacramento.
Colorado	J. A. Newcomb	Golden	J. F. White	Arvada
Connecticut	B. C. Patterson	Torrington	Frank S. Hopson	Station 3, Bridgeport.
Dakota[a]				
Delaware	S. H. Derby	Woodside	A. T. Neale	Newark
Illinois	Oliver Wilson	Magnolia	E. H. Clark	Dunlap
Indiana	Aaron Jones	South Bend	Mrs. L. G. Robertson	South Bend
Iowa	A. B. Judson	Hillsdale	Geo. Van Houden	Lenox
Kansas, including Oklahoma.	E. W. Westgate	Manhattan	A. P. Reardon	McLouth
Kentucky	F. P. Wolcott	Covington	J. B. Wallser	Hopkinsville
Maine	Obadiah Gardner	Rockland	W. K. Thompson	South China
Maryland	Joseph B. Ager	Hyattsville	Prof. J. S. Robinson	College Park
Massachusetts	Geo. S. Ladd	Sturbridge	Chas. H. Rice	Leominster
Michigan	Geo. B. Horton	Fruitridge	Mrs. F. D. Saunders	Rockford
Minnesota	Mrs. S. G. Baird	Edina Mills	Geo. C. Hill	Sherburne
Mississippi	S. L. Wilson	Okolona	H. F. Simrall	Glass
Missouri	C. O. Raine	Monticello	T. B. Dunham	New Cambria
Nebraska	J. M. Williams	Culbertson	A. M. Bovee	Vacoma
New Hampshire	N. J. Bachelder	Concord	Henry H. Metcalf	Concord
New Jersey	Geo. W. F. Gaunt	Mullica Hill	Geo. L. Dillingham	Moorestown
New York	Elliot B. Norris	Sodus	Mrs. B. B. Lord	Sinclairville
Ohio	F. A. Derthick	Mantua	S. E. Strode	Westland
Oregon, including Idaho.	B. G. Leedy	Tigardville	Austin T. Buxton	Forestgrove
Pennsylvania	W. F. Hill	Westford	A. M. Cornell	Altus
Rhode Island	A. A. Smith	Woonsocket	T. S. Snow	Wakefield
South Carolina	W. K. Thompson	Libertyhill	C. J. Rollins	Stokes Bridge
Tennessee	W. L. Richardson	Brownsville	J. M. McCorkle	Whitehaven
Texas	R. D. McGee	Stockdale	John B. Long	Rusk
Vermont	C. J. Bell	East Hardwick.	R. B. Galusha	South Royalton.
Washington	J. O. Wing	Mount Pleasant.	James Wheelhouse	Columbus
West Virginia	T. C. Atkeson	Morgantown	S. C. Moore	Elwell
Wisconsin	A. C. Powers	Beloit	S. C. Carr	Milton Junction

[a] Annexed to Minnesota; also Idaho is included with Oregon, Oklahoma with Kansas, and Indian Territory with Texas.

STATE GRANGES.

1901, so far as reported on April 1.

Treasurer.	Post-office.	Secretary.	Post-office.	Date of meeting.
W. J. Roundtree	Valegrande	F. Shackelford, jr.	Colquitt	Wednesday after second Monday in July.
Daniel Flint	620 N street, Sacramento.	Mrs. L. S. Brasch	1251 11th avenue, San Francisco.	First Tuesday in October.
W. W. Groves	Globeville	Will. T. Wilson	Niwot	Second Tuesday in January.
Norman S. Platt	835 Whalley avenue, New Haven.	H. E. Loomis	Glastonbury	Do.
....	....	....	....	
Thomas H. Riggin	Laurel	W. W. Seeders	Farmington	Second Tuesday in December.
D. Q. Trotter	Piasa	Thomas Keady	Dunlap	Do.
J. W. Holmes	Seymour	Taylor B. Frazier	Frankfort	Do.
W. H. Hollister	Manchester	John Turner	Lenox	Second Tuesday in October.
William Henry	Olathe	George Black	Olathe	Second Tuesday in December.
Clinton Gaines	Bullittsville	Miss Nannie D. Bristow.	Union	October.
M. B. Hunt	CenterBelmont.	E. H. Libby	R. R. 4, Auburn.	December.
Geo. H. Merryman	Bosley	Wm. B. Sands	Lake Roland	Do.
F. A. Harrington	Worcester	Wm. N. Howard	South Easton	Do.
E. A. Strong	Vicksburg	Miss Jennie Buell	Ann Arbor	Do.
C. Varley	Sherburne	Mrs. A. J. Adams	Box 447, Minneapolis.	Second Tuesday after December 4.
Mrs. Joe Bailey	Conchatta	T. J. Aby	Fayette	Second Tuesday in December.
W. B. Haines	Gilman City	E. H. Long	Monticello	Second Tuesday in October.
B. S. Gitchell	Butler	J. R. Cantlin	Webster	Second Tuesday in December.
Joseph D. Roberts	Salmon Falls	E. C. Hutchinson	Milford	Third Tuesday in December.
C. Collins	Moorestown	M. D. Dickinson	Woodstown	First Thursday in December.
P. A. Welling	Hannibal	W. N. Giles	Skaneateles	First Tuesday in February.
W. W. Miller	Columbus	C. M. Freeman	Tippecanoe City (R. D. 64).	Second Tuesday in December.
J. Hershberg	Independence	Mrs. Mary S. Howard.	Mulino	Fourth Tuesday in May.
S. E. Niven	Landenburg	J. T. Ailman	Thompsontown.	Second Tuesday in December.
Benjamin Martin	East Providence	Alton F. Coggeshall	South Portsmouth.	Do.
H. Boykin	Ionia	W. A. James	Bishopville	Second Wednesday in December.
D. A. Stewart	Brownsville	Mrs. E. L. Allen	Brownsville	Third Tuesday in August.
J. L. Howell	Dublin	J. J. Ray	Dublin	Second Tuesday in August.
F. B. Pier	Rawsonville	A. A. Priest	Randolph	Second Wednesday in December.
William Smiley	Vancouver	F. C. Briggs	Lacenter	First Tuesday in June.
Alex. Clohan	Martinsburg	M. V. Brown	Buffalo	Second Wednesday in January.
George Harwood	Chippewa Falls.	H. E. Huxley	Neenah	Second Tuesday in December.

OFFICIALS CHARGED WITH AGRICULTURAL INTERESTS IN SEVERAL COUNTRIES.

Argentina.—Minister of agriculture. Official address: Su excelencia el ministro de agricultura, ministerio de agricultura, Buenos Aires.

Austria-Hungary.—Minister of agriculture at Vienna and minister of agriculture at Budapest. Official addresses: K. k. Ackerbau-Minister in Wien, and K. ungarischer Ackerbau-Minister in Budapest.

Belgium.—Minister of agriculture. Official address: Ministère de l'agriculture, Bruxelles.

Brazil.—Minister of industry, etc. Official address: Ministro da industria, viação e obras publicas, Rio de Janeiro.

Chile.—Minister of industry, etc. Official address: Ministro de industria y obras publicas, Santiago.

China.—No officer of central government. Provincial officers: His excellency the viceroy of Liang-Kiang, Nankin. His excellency the viceroy of Hu-Kuang, Wuchang. His excellency the viceroy of Liang-Kwang, Canton.

Costa Rica.—Minister of public promotion. Official address: Ministro de fomento, San Jose.

Denmark.—Official address: Landbrugsminister, 6 Slotholmsgade, Copenhagen.

France.—Minister of agriculture. Official address: Monsieur le ministre de l'agriculture, No. 78 rue de Varennes, Paris.

Germany.—Official address: Secretary of the interior, Berlin.

Great Britain.—Official address: President of the board of agriculture, 4 Whitehall place, London S. W.

Guatemala.—Minister of public promotion. Official address: Ministro de fomento, Guatemala City.

Haiti.—Secretary of state for agriculture. Official address: Secrétaire d'état de l'agriculture, Port au Prince.

Italy.—Director-general of agriculture, etc. Official address: Direttore generale dell' agricoltura, industria, e commercio, Roma.

Japan.—Minister of agriculture. Official address: Minister of agriculture and commerce, Tokyo.

Korea.—Official address: Minister of agriculture, Seoul.

Mexico.—Secretary of public promotion. Official address: Secretario de fomento, City of Mexico.

Nicaragua.—Minister of public promotion. Official address: Ministro de fomento, Palace of the Executive, Managua.

Russia.—Minister of agriculture. Official address: Minister of agriculture and state domains, St. Petersburg.

Spain.—Minister of agriculture, etc. Official address: Ministro de agricultura, Madrid.

Sweden and Norway.—Official addresses: General direktör och chef för kongl. domänstyrelsen, Stockholm. Skogdirektör, Christiania.

Switzerland.—Official address: Chef du département fédéral du commerce, de l'industrie et de l'agriculture, Palais Fédéral, Bern.

Turkey.—Official address: Minister of agriculture, Constantinople.

Venezuela.—Official address: Dirección de agricultura y cria, Caracas.

AGRICULTURAL OFFICIALS IN AUSTRALIA AND SOUTH AFRICA.

Ministers and Secretaries for Agriculture.

New South Wales	John Kidd.	Sydney.
Victoria	J. Morrissey	Melbourne.
South Australia	R. Butler	Adelaide.
Queensland	D. H. Dalrymple	Brisbane.
Tasmania	E. Mulcahy	Hobart.
New Zealand	Thomas Young Duncan	Wellington.
Cape Colony	Sir P. H. Faure	Cape Colony.
Natal	H. D. Winter	Pietermaritzburg.

CANADIAN OFFICIALS IN CHARGE OF AGRICULTURE.

Ministers of Agriculture.

Dominion of Canada	Sydney A. Fisher	Ottawa.
Ontario	John Dryden	Toronto.
Quebec	F. G. M. Déchêne	Quebec.
British Columbia	J. D. Prentice	Victoria.
Manitoba	R. P. Roblin (*also* Premier)	Winnipeg.

Commissioners of Agriculture.

New Brunswick	L. P. Farris	Fredericton.
N. W. Territories	G. H. V. Bulyear	Regina.
Prince Edward Island	Benjamin Rogers	Charlottetown.

Secretary of Agriculture.

Nova Scotia	B. W. Chipman	Halifax.

Minister of Agriculture and Mines.

Newfoundland	Eli Dawe	St. Johns.

REVIEW OF WEATHER AND CROP CONDITIONS, SEASON OF 1901.

By JAMES BERRY, *Chief Climate and Crop Division, Weather Bureau.*

The accompanying tables and diagrams (see figures 48, 49, 50, 51, and 52, pages 642, 643, 644, 645, and 646) show how the temperature and rainfall over the United States during the crop season of 1901 from week to week compares with normal conditions of corresponding periods of former years. In the large tables are given departures from normal temperature and precipitation (in degrees Fahrenheit and inches and hundredths, respectively) for Weather Bureau stations by months, from January 1 to March 31, and by weeks ending Mondays at 8 a. m., seventy-fifth meridian time from April 8 to September 30. The diagrams exhibit the departures from normal, by districts, for the same period and the other three figures show respectively the departures from normal temperature, the total precipitation, and departures from normal precipitation during the crop season.

The features of the year were a favorable harvest for a heavy wheat crop and a severe drought which cut the corn very short.

CONDITIONS FROM JANUARY TO APRIL.

JANUARY.

January, 1901, averaged mild generally throughout the country with decided temperature excess in the central valleys and to the westward of the Mississippi except on the immediate north Pacific coast, where there was a slight deficiency in temperature. The precipitation was below the average over much the greater part of the country, the most marked deficiency occurring in the central valleys, middle Atlantic and west Gulf States. The weather conditions were generally favorable for winter wheat except in Kansas, Missouri, and Texas, where lack of moisture proved detrimental, and in the Middle Atlantic States where the crop suffered in consequence of lack of snow protection and from alternate thawing and freezing. On the Pacific coast the rainfall was ample and at the close of the month the outlook for wheat was excellent.

FEBRUARY.

February averaged decidedly cold from the Atlantic coast westward to the Mississippi Valley and also over the middle and southeastern Rocky Mountain slopes. In the upper Missouri Valley, plateau districts, and on the Pacific coast it was milder than usual. There was abundant rainfall in the Pacific coast, South Atlantic, and Central Gulf States, but the month was very dry in the central valleys, Lake region, and middle Atlantic States. The reports respecting wheat from the southern portion of the winter wheat region were for the most part unfavorable, owing to general lack of snow protection and to freezing and thawing. Over the northern portion of the winter wheat belt, however, there was ample snow covering, and the crop was in very promising condition. On the Pacific coast the outlook for winter wheat continued

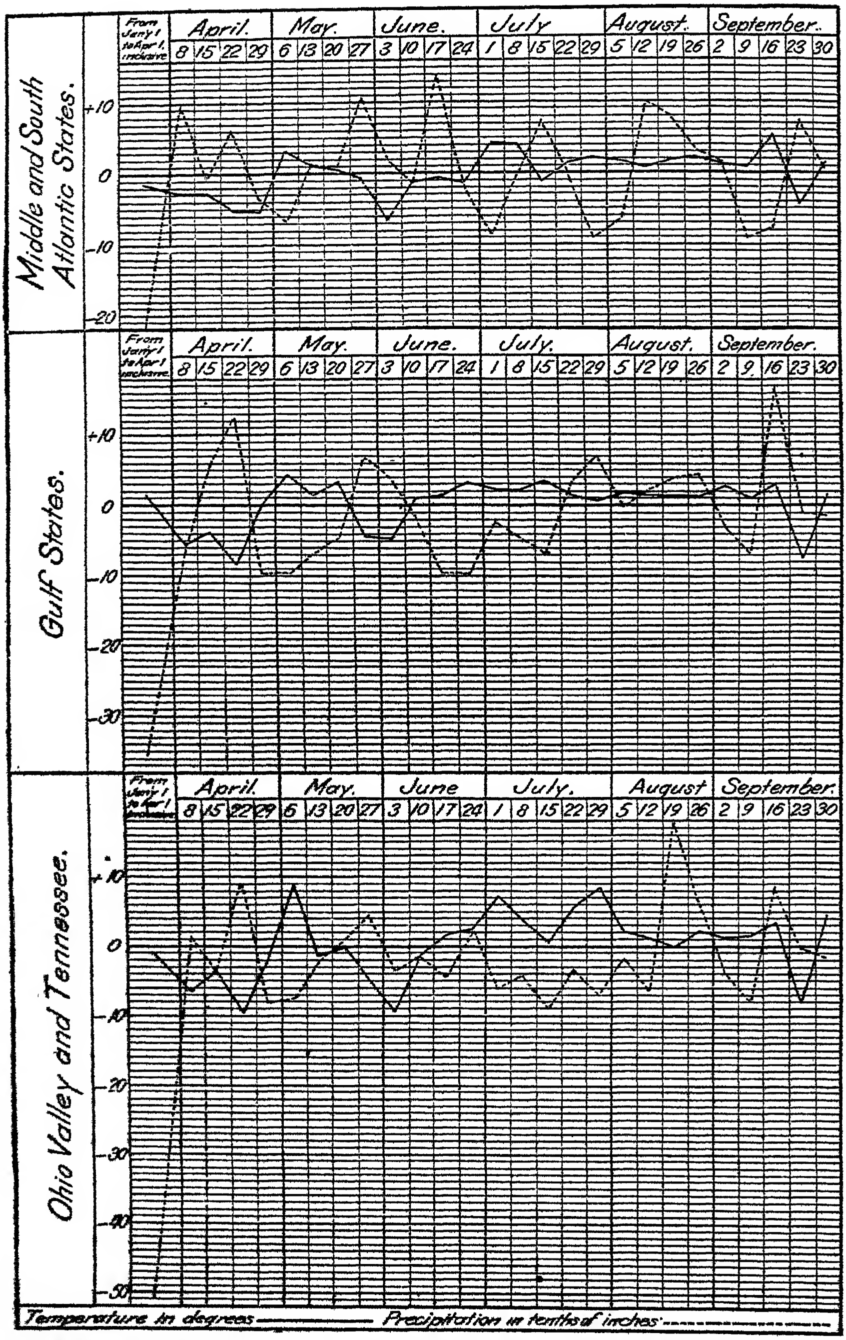

FIG. 48.—Temperature (degrees Fahrenheit) and precipitation (inches) departures for the season of [illegible] from the normal of many years for the Middle and South Atlantic States, the Gulf States, and the Ohio Valley and Tennessee.

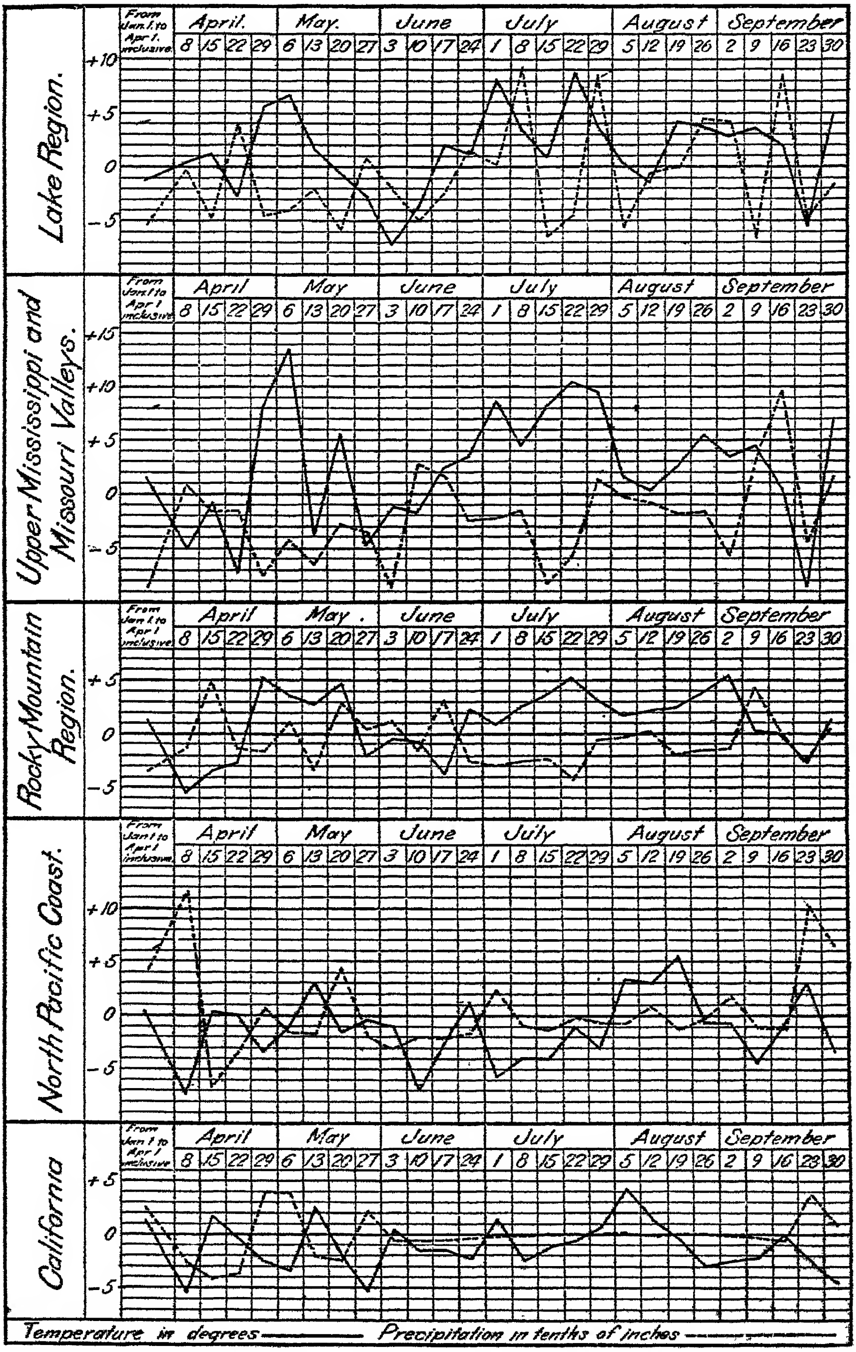

FIG. 49.—Temperature (degrees Fahrenheit) and precipitation (inches) departures for the season of 1901 from the normal of many years for the Lake region, the upper Mississippi and Missouri valley, the Rocky Mountain region, the North Pacific coast and California.

excellent, although its growth was checked by low temperatures during the first and last decades. The Southern States experienced very trying temperature conditions from the 20th to the 25th, when freezing weather occurred as far south as central Florida. Although February averaged unusually cold in the Southern States,

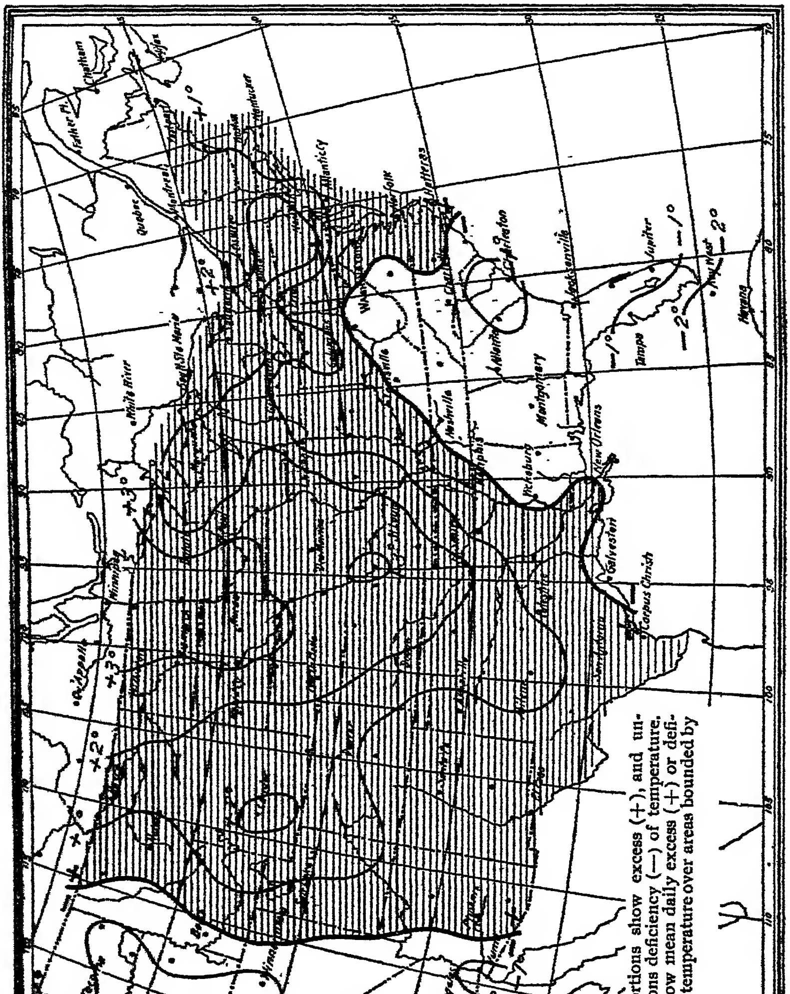

FIG. 50.—Average daily departures from normal temperature for the crop season of 1901, from March 1 to September 30.

farm work was actively carried on, and by the close of the month some corn had been planted in Texas and Florida and oat seeding had begun in portions of the Central Gulf States.

MARCH.

From the central Mississippi Valley eastward to the middle Atlantic States the weather conditions of March were generally favorable for farm work, but in the

States of the Missouri Valley and upper Lake region they were less favorable. Drought prevailed in central and western Texas, and heavy rains interfered with farm work and caused injury by washing prepared lands in the South Atlantic and East Gulf States in the latter part of the month. The month was unusually favorable in

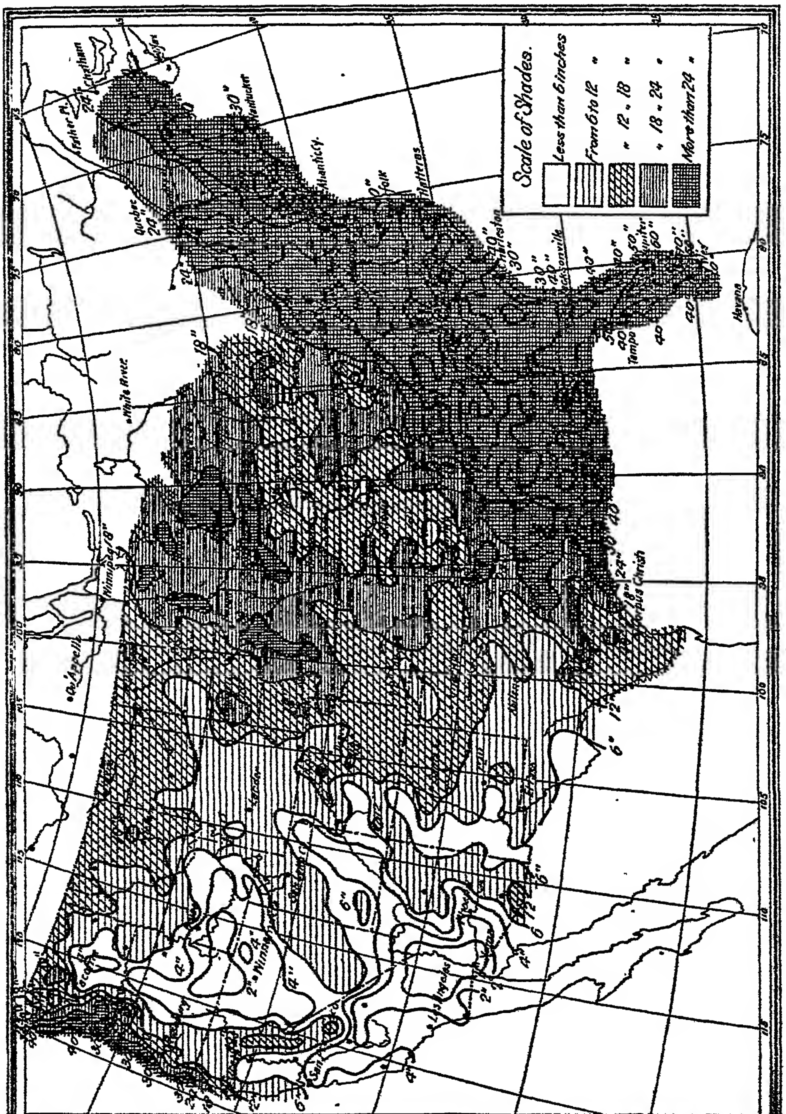

FIG. 51.—Total precipitation for the crop season of 1901, from March 1 to September 30.

California, but in Oregon cold rains and frequent frosts delayed work and retarded growth. By the close of the month preparations for corn planting were in progress as far north as Kansas, Missouri, Kentucky, and Virginia, some planting having been done in the southern portions of Kansas and Missouri, while farther south a large part of the corn crop had been planted. Oat seeding was well advanced as far north as the Ohio and central Mississippi valleys. Some cotton was planted in Alabama and southern Texas, and extensive preparations for planting in other portions

of the cotton belt were well advanced. The general condition of winter wheat was better than at the close of February, but unfavorable reports continued from portions of the Ohio Valley.

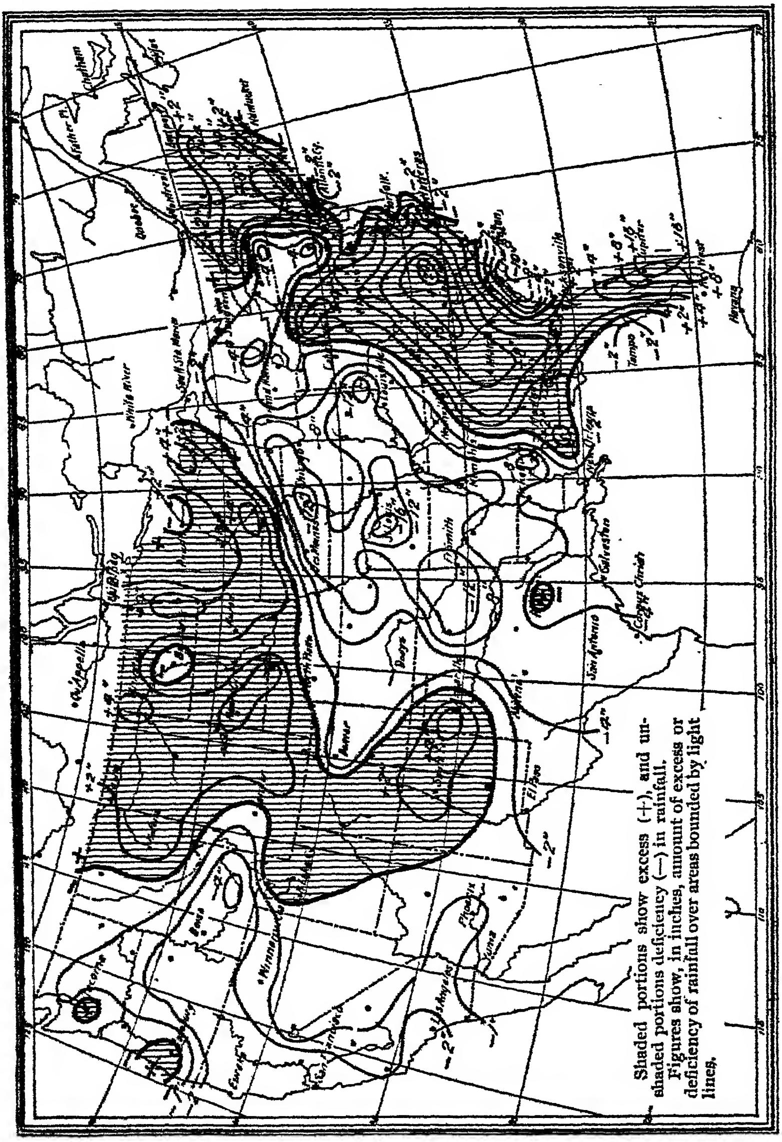

FIG. 52.—Departures from normal precipitation for the crop season of 1901, from March 1 to September 30.

SUMMARY OF THE SEASON, BY WEEKS.

By weeks, ending with Monday, from April 8 to September 30, the crop conditions may be summarized as follows:

CORN-PLANTING TIME.

April 8.—This week was generally cold with heavy rains in the Atlantic coast districts, lower Missouri Valley and on the north Pacific coast, and heavy snowfall over

portions of the lower Lake region, middle Atlantic States, and New England. These conditions greatly interfered with farming operations, which were generally late, especially in the central valleys and Atlantic coast districts, due in part to the heavy rains of March. In central and western Texas, however, rain was much needed. But little progress with corn planting was made except in the extreme southern districts, where it was nearing completion in some sections. Slow germination and poor stands were generally reported from the Southern States. A very general improvement in the condition of winter wheat was reported, except in portions of Ohio, Illinois, Oklahoma, and Texas, where damage by insects was more or less apparent, the last-named State reporting unfavorable effects of drought. On the Pacific coast the outlook for winter wheat continued promising, but the crop needed rain over a large part of California. Some spring wheat was sown in portions of Iowa, but none in the Red River Valley. Preparations for cotton planting were delayed by excessive rains in portions of the Carolinas, Georgia, and Alabama, but over the central districts good progress was made and planting was in operation as far north as Arkansas, northern Mississippi, and North Carolina.

April 15.—Over the greater part of the country east of the Rocky Mountains the weather was abnormally cool and unfavorable for germination and growth. Excessive rains retarded farm work in the States of the middle Rocky Mountain slope and Lower Missouri Valley, while a large part of the Lake region, southern Florida, and California needed rain. With the exception of portions of the Lake region, Florida, Texas, and California, there was generally ample moisture in the soil, the conditions most needed, especially in the central valleys and Middle Atlantic States, being sunshine and warmth. In Texas, where it had been very dry, good rains fell over the eastern and central portions of the State. Slow progress was made with corn planting, none having been planted north of the Ohio River or farther north than southern Missouri to the westward of the Mississippi, and poor stands were generally reported in the Southern States. Nearly all reports from the winter wheat States showed that winter wheat had made favorable progress, although its growth was not rapid. On the Pacific coast the condition of the crop continued promising, with the exception of the late sown in California, which was suffering for rain. Cool weather retarded cotton planting and that planted germinated slowly. In Virginia, the Carolinas, and Kentucky, tobacco plants were very backward, but in Maryland they were in a more thrifty condition. The effects of the frosts of the previous week to deciduous fruits in California, while serious, were less damaging than first estimated. In southern Oregon fruit suffered considerably from frosts.

April 22.—This was the fourth consecutive week of abnormally cold weather over nearly the whole country, with the most marked temperature deficiency of the season in the central valleys and Southern States, and heavy precipitation throughout the Ohio Valley and over the greater portion of the Atlantic coast and Gulf districts. These conditions were very unfavorable for farming operations, germination, and growth, and the heavy rains resulted in destructive freshets, especially in the Ohio Valley. Freezing temperatures occurred as far south as eastern Tennessee and western North Carolina. Very slow progress was made with corn planting, none having been planted north of the Ohio River. While the growth of winter wheat was materially retarded by low temperatures, the previously reported promising condition of this crop was maintained. In Oklahoma and Texas, however, insects continued to cause serious damage. On the Pacific coast the condition of winter wheat was promising, except the late-sown in portions of California. But little spring wheat had been sown in North Dakota, and while seeding was well advanced in portions of Minnesota and South Dakota, much less was sown than at the corresponding date of the previous year. This week was very unfavorable for cotton planting over a large portion of the cotton belt, more particularly the central districts. The early planted came up to poor stands generally, and in Texas and Georgia some damage was done by frost.

April 29.—This was the most favorable week of the season to date, although the first part was much too cool in the Ohio Valley, Atlantic coast, and east Gulf districts, and on the north Pacific coast. In the States of the upper Mississippi and Missouri valleys and over the eastern Rocky Mountain slope ideal weather conditions prevailed, the temperature being exceptionally mild and highly favorable for farming operations, germination, and growth. Rapid progress was made preparing ground for corn planting in the States of the central Mississippi and lower Missouri valleys, but this work was much delayed in the Ohio Valley and Middle Atlantic States. Winter wheat continued in generally promising condition. Excepting high winds in the Dakotas during the latter part of the week, which uncovered in places and in others deeply covered late-sown spring wheat, the conditions were highly favorable for seeding and germination, seeding being well advanced over the northern portion of the spring-wheat region and practically finished on the north Pacific coast. The unfavorable

effects of the frosts of the previous week appeared to have been more serious to cotton in the central districts of the cotton belt than was indicated in the preceding week. Much of the crop that was up prior to the 18th in Mississippi, Louisiana, and Alabama was killed, necessitating extensive replanting. The bulk of the Texas crop was planted, and planting was progressing rapidly over the northern portion of the cotton region. Some tobacco was transplanted in South Carolina, but none farther northward.

May 6.—The temperature conditions of this week in nearly all districts east of the Rocky Mountains were highly favorable, but rain was needed over the greater part of the Gulf and South Atlantic States as well as in portions of the Lake region and central valleys. The Middle Atlantic States and the northern portion of the upper Mississippi and Missouri valleys experienced an exceptionally favorable week. It was rather cool on the Pacific coast, but as a whole the conditions were favorable. Very beneficial rains, phenomenally heavy in places, fell over the central plateau region and eastern Rocky Mountain slope. Corn planting progressed rapidly in the central valleys, was begun in the extreme northern districts, and about finished as far north as the Carolinas, Tennessee, and Arkansas. In the Southern States the stands were poor and the crop generally needed rain, although it was somewhat improved as compared with its condition at the close of the previous week. Reports respecting winter wheat continued favorable excepting over portions of Texas, Oklahoma, southeastern Kansas, and Michigan. On the Pacific coast, especially in California, the weather conditions were highly favorable to winter wheat. The bulk of the spring-wheat crop was sown, the early planted being in promising condition. Rain was very generally needed throughout the cotton belt to germinate the very large part of the crop replanted after the cold of April 18. While planting was delayed by dry weather in Texas, this work made good progress elsewhere and was nearly completed over the northern portion of the central districts.

SEASON OF CULTIVATION AND GROWTH.

May 13.—While this week was abnormally cool in the upper Mississippi and Missouri valleys, with frosts more or less damaging in the Missouri Valley, the temperature conditions as a whole were favorable, but the area needing rain was much greater than in the previous week, and the effects of drought more serious, especially in the Gulf States. The generally abundant rains of the previous week over the western plateau and Pacific coast districts, followed by much warmer weather, were highly favorable in that region. Corn planting in the central Missouri and Mississippi valleys was somewhat delayed on account of low temperatures. In the Ohio Valley and Middle Atlantic States planting made favorable progress, but was somewhat delayed in portions of West Virginia and Ohio. In the Southern States the crop was very uneven, made slow growth, and was generally in need of rain, although showers afforded relief in sections. The general absence of rain over a large part of Nebraska, Kansas, and southern Missouri somewhat checked the progress of winter wheat, but elsewhere in the winter wheat belt the condition of the crop continued generally very favorable, a decided improvement being reported from Michigan and Ohio. In Texas no improvement was reported. In the western and central portions and over a considerable area in the eastern part of the cotton belt rain was much needed for cotton. That planted after the cold of the latter part of April germinated poorly, the stands being very irregular and unsatisfactory generally throughout the central and western districts. In the Carolinas fair to good stands and generally improved conditions were reported. Transplanting of tobacco was about finished in South Carolina, was in rapid progress in North Carolina, and well advanced in Maryland, Virginia, and Tennessee, plants being generally plentiful.

May 20.—Although frosts occurred in the Lake region, upper Ohio Valley, and northern portion of the Middle Atlantic States, only slight damage resulted, and as a whole the temperature conditions throughout the country were very favorable. Drought was largely relieved in the Southern States, but continued in western and southern Texas, southern Louisiana, and portions of Alabama and Florida, and the continued absence of rain in the central valleys and Lake region proved detrimental. The Pacific Coast States experienced a very favorable week, although it was rather cool, with too much rain in western Washington. In the States of the lower Missouri and the upper Mississippi and Ohio Valleys, corn planting progressed rapidly and was nearing completion, planting being well advanced in the Lake region, Minnesota, and the Dakotas. Winter wheat needed rain in the lower Missouri Valley, but experienced improvement in the upper Ohio Valley and Michigan. Wheat was heading as far north as the Middle Atlantic States and the southern portion of the central valleys, and harvest began in Texas, where the crop was generally poor. On the Pacific Coast the reports continued promising, the crop having experienced a decided improvement in California. Spring wheat was coming up well and the early

sown made good growth, but rain was needed to germinate some of the late sown. An improvement in the condition of cotton was reported from the Carolinas, Georgia, Alabama, Florida, and portions of Texas.

May 27.—In nearly all districts east of the Rocky Mountains this week was abnormally cool, with excessive rains from the South Atlantic and East Gulf coasts northward to the lower Lake region, and a continuation of drought in portions of the Missouri, central and lower Mississippi valleys, and portions of Texas. A large amount of damage was done by freshets in Virginia, the Carolinas, Georgia, and Tennessee. Frosts were of general occurrence throughout the Rocky Mountain districts and in the upper Missouri Valley and upper Lake region, causing slight damage in most of these districts. On the Pacific coast the week was generally favorable, except in California, where it was unseasonably cool and rains caused serious injury to hay and fruit. Corn made slow growth in the central Mississippi and Ohio valleys, but in the Southern States a general improvement occurred. In Iowa and Nebraska the stands were good. Planting was generally finished, except over the northern portion of the Middle Atlantic States and New England, where this work was much retarded. Wheat continued in need of rain in the lower Missouri and central Mississippi valleys, but experienced further improvement in the central and upper portions of the Ohio valley. The Hessian fly caused damage in portions of Kansas, Missouri, Illinois, and Michigan, and the crop sustained considerable injury as a result of heavy rains in Maryland, Virginia, and North Carolina. Harvesting began this week in the east Gulf States. In California the wheat outlook was excellent, except in the southern part of the State, but in Oregon it was less promising than previously reported, owing to ravages of insects. Spring wheat was much in need of rain over the western portion of the spring-wheat region, but over the eastern portion the condition of the crop was promising. A very general improvement in the condition of the cotton occurred. The growth of the crop over the northern portions of the central and western districts, however, was slow, and large areas in the Carolinas were submerged. Transplanting of tobacco was in general progress in the Ohio Valley and Middle Atlantic States under very favorable conditions. Plants were generally abundant, except in Kentucky.

June 3.—Practically an entire absence of rain over a large part of the Missouri and upper Mississippi valleys intensified the drought conditions previously existing in these districts, while the greater part of the region extending from the east Gulf coast to the lower Lake region and New England suffered further from excessive rains. The week was abnormally cool to the eastward of the Mississippi River and in the west Gulf States, with frosts in the central Rocky Mountain districts, upper Lake region, Kansas, and Oklahoma, causing little or no damage, except in northern Wisconsin. Temperatures much above the average occurred in the upper Missouri and Red River of the North valleys. The northern Rocky Mountain and Pacific Coast districts experienced very favorable conditions. On the whole, this week was very unfavorable to corn, which made very slow growth through the principal corn States, damage by cutworms being extensively reported. In the Southern States, however, further improvement in the condition of the crop was generally reported. Planting was much retarded over the northern portion of the Middle Atlantic States and New England. In the States of the lower Missouri Valley winter wheat suffered further from drought and fly, the most marked deterioration being shown in Missouri. Harvesting was begun as far north as Arkansas. Spring wheat generally needed rain throughout the spring-wheat region, especially in the Dakotas. The crop, however, made fair progress in portions of the Dakotas, and notwithstanding the dry weather made good growth in Minnesota. Cotton made very slow growth generally throughout the cotton belt, and suffered for cultivation over the eastern and portions of the central districts.

June 10.—Much needed and generally abundant rains occurred in the spring-wheat region which had suffered from protracted drought, and the drought conditions in the lower Missouri Valley were largely relieved, though portions of Missouri continued to need rain. Damaging frosts occurred from Washington and Oregon eastward over the northern Rocky Mountain districts to the upper Mississippi Valley, the week averaging decidedly cool in these districts, the Lake region, and over the northern portions of the central valleys and Middle Atlantic States. As a whole, the week was favorable in the districts east of the Rocky Mountains—especially so in the Middle Atlantic States and Ohio Valley. While the weather was less unfavorable to corn than in the previous week, the crop continued to make slow progress in the principal corn States. A slight improvement was, however, quite generally reported over the southern portion of the corn belt, and generally throughout the Southern States. In Minnesota and the Dakotas corn was seriously damaged by frost. Winter wheat experienced improvement in the States of the lower Missouri Valley, but in

portions of the Ohio Valley and in Michigan and New York its condition was less favorable. Harvest was in progress in North Carolina, Tennessee, and in the southern portions of Missouri and Kansas, and wheat was beginning to ripen in Maryland and Virginia. An unusually fine crop was being harvested in California, and the bulk of the crop in Oregon was in fine condition. Generally abundant rains caused decided improvement in spring wheat throughout the spring-wheat region, and the crop was in more promising condition than at any previous period of the season. Cotton improved over the western portion of the cotton belt and in Tennessee, and in portions of the Carolinas, but in Georgia, Alabama, Mississippi, and the southern portion of South Carolina made very slow growth, was very backward, and, in some sections, much in need of cultivation. Some fields in North Carolina were plowed under for other crops.

TIME OF WHEAT HARVEST.

June 17.—The central valleys, Lake region, Atlantic coast districts, and Southern States experienced the most favorable temperature conditions of the season to date, but throughout the Rocky Mountain and Pacific coast regions the week was decidedly cool, with frosts, more or less damaging, in the central and northern Rocky Mountain districts and portions of California. Abundant and beneficial rains fell over portions of the middle Rocky Mountain slope and throughout the spring wheat region, and excessively heavy and damaging rains occurred in the South Atlantic States, while portions of Texas, Missouri, and Illinois continued to suffer from drought. A general and decided improvement in the condition of corn was reported from the principal corn States. Cutworms, however, caused damage in the Dakotas, and in the South Atlantic States the crop suffered seriously from lack of cultivation, due to excessive rains. Winter wheat harvest became more general in Kansas and Missouri, and began in southern Illinois and Virginia. The crop experienced very favorable conditions in the central valleys, although damage by fly continued in some sections. Spring wheat made rapid advancement in the Dakotas and Minnesota, being in excellent condition in the last-named State. In the western and central portion of the cotton belt cotton generally improved and was well cultivated, though needing rain in some sections. In the Carolinas, Georgia, and Florida heavy rains caused much damage and the crop was greatly in need of cultivation. Transplanting of tobacco was practically finished in Kentucky, Virginia, and Maryland, and well advanced in Pennsylvania, Ohio, and Indiana, the general outlook being encouraging.

June 24.—The temperature conditions of this week were highly favorable in nearly all parts of the country, especially in the Rocky Mountain region and on the Pacific coast, where the previous week was abnormally cool. The South Atlantic States, which suffered from excessive rains in the previous week, experienced more favorable conditions for cultivation, but rain was very generally needed in the central and west Gulf States, Arkansas, and southern Missouri. Further and general improvement in the condition of corn was indicated. Winter wheat harvest advanced under favorable conditions and was now in progress in the northern portion of the central and western districts of the winter wheat belt. The spring wheat region experienced very favorable weather conditions and the outlook for spring wheat was most encouraging, although in northern Minnesota lodging was threatened.

July 1.—In the districts east of the Rocky Mountains this week was intensely hot, with drying winds in Texas and the States of the lower Missouri Valley and middle Rocky Mountain slope. East of the Mississippi River the excessive heat had so far caused no serious injury, although portions of the Ohio Valley, Tennessee, and the central Gulf States were greatly in need of rain. In the central and northern plateau districts and on the Pacific coast the week was abnormally cool, with light frosts in exposed places in Idaho and Utah. Abundant rains fell from central Montana eastward to the upper Lake region, over portions of the Ohio Valley and local areas in the South Atlantic and Gulf States. Corn made good growth in the principal corn States, but suffered for rain in Missouri and Kansas. In the Ohio Valley and Middle Atlantic States corn was backward, and in the upper Ohio Valley suffered from lack of cultivation. In the central and west Gulf States, including Arkansas, corn was seriously injured by drought. Under the high temperatures of this week grain ripened rapidly, and harvesting of winter wheat made rapid progress, being nearly finished in Kansas and Missouri, and thrashing was well advanced in the central valleys. In the upper Ohio Valley a considerable portion of the crop was badly lodged. Favorable reports continued from the Pacific coast. In Minnesota the condition of spring wheat continued excellent, and in the Dakotas the outlook was generally favorable, although some injury was done by excessive rains on lowlands. Cotton was standing the drought very well, although in general need of rain in the

central portions of the cotton belt. In portions of southern Texas the rainfall was ample, but the crop in that State generally needed rain. A general improvement was indicated in the eastern districts, but the condition of the crop in South Carolina and Georgia continued unpromising. All reports respecting tobacco were favorable, with the exception of those from Tennessee and South Carolina, the crop needing rain in the former State and suffering from lack of cultivation in the latter.

July 8.—While the average daily temperature excess for the week ending July 8 was not quite so marked as in the previous week in the central valleys, it was more decided in the middle Atlantic coast districts. No seriously injurious effects to crops from the intense heat was reported from the Middle Atlantic States, but from Texas northward to Nebraska, including Missouri, Arkansas, and portions of Illinois, Kentucky, and Tennessee, crops suffered to a greater or less extent. The weather conditions on the Pacific coast and in the plateau regions were favorable, although frosts caused some injury in Utah and Wyoming on the 5th. In Kansas, Missouri, Oklahoma, Texas, and Arkansas corn was seriously damaged by intense heat and drying winds, although late corn in Kansas continued in fair condition. The bulk of the crop in Nebraska and Iowa had so far escaped injury except in a few southwest counties in Nebraska, but in southeastern Iowa it was threatened. In the States of the Ohio Valley corn suffered no injury from heat, and generally made good growth. Wheat harvest was finished in Kansas, Missouri, and the lower Ohio Valley, but was delayed by rain in portions of Ohio and West Virginia. Reports of injury by the Hessian fly continued from Ohio and portions of Pennsylvania and New York. In the Dakotas, Minnesota, Oregon, and Washington spring wheat was generally in a very promising condition, although areas in northern Minnesota were flooded. The crop suffered from drought in portions of South Dakota, and in Iowa the excessive heat caused it to ripen too rapidly. In the central and eastern portions of the cotton belt, with the exception of South Carolina and Florida, cotton, though small, was generally growing and fruiting well. In Tennessee and to the westward of the Mississippi River cotton was much in need of rain, especially on the uplands of Texas and portions of Arkansas. Tobacco suffered somewhat from heat in Maryland and Virginia and its growth was checked by drought in portions of Tennessee and western Kentucky. The general condition of the crop, however, was satisfactory.

SERIOUS INJURY BY HEAT AND DROUGHT.

July 15.—This was the third consecutive week of intense heat in the States of the middle Rocky Mountain region and the Missouri Valley and the western half of the Mississippi Valley, the maximum temperatures over a large part of these districts ranging above 100° daily, many stations reporting from 100° to 107°. With an almost entire absence of rain the crops in the region named were subjected to most unfavorable conditions. While very high temperatures also prevailed in the States lying immediately eastward of the Mississippi, the heat was less intense and its effects not so serious as in the districts westward. On the Atlantic coast very favorable temperature conditions prevailed, with abundant rains, which, however, were excessive and damaging in portions of the Middle and South Atlantic States. On the Pacific coast the week was cool and dry, with frost in Washington on the 12th. The corn crop as a whole in the great corn States of the central valleys materially deteriorated, sustaining serious injury over the western portion of the corn belt, especially in Missouri, Nebraska, Kansas, and Oklahoma. A very large part of the crop was late, however, and withstood the trying conditions of drought and heat remarkably well, particularly in Iowa, Nebraska, and portions of Kansas and northern Missouri. Early corn in central and southern Missouri, portions of eastern Kansas, Arkansas, and in the central and west Gulf States was irreparably injured. In the upper Ohio Valley, corn, while needing rain, improved, and in the Atlantic coast districts the crop made excellent progress. Winter wheat harvest was about finished, except in the more northerly portion of the Atlantic coast districts, where in some sections it was retarded by rain. Harvesting began in the north Pacific coast region under very favorable conditions. Over the southern portion of the spring wheat region spring wheat ripened prematurely, and the general prospect was less promising than previously reported. In the northern portion, however, the outlook continued favorable. Except in the Carolinas and Florida cotton was generally well cultivated, and over the greater part of the central and western districts was standing the drought well, although fruiting at the top was commonly reported. Cotton suffered from heavy rains in North Carolina, and in Georgia the prospect was much below the average, many fields being abandoned. In southwest Texas early cotton was opening and some picking done. The weather was highly favorable for tobacco in the Atlantic coast States, but it needed rain in the Ohio Valley, and suffered severely in the western portions of Kentucky.

July 22.—This was another week of intense heat throughout the States of the central valleys and middle Rocky Mountain region, with only local showers over limited scattered areas. Maximum temperatures of 100° or above were of daily occurrence over more or less of the territory named. Under these conditions the drought was greatly intensified and its area largely increased. Missouri, Kansas, Oklahoma, and portions of Nebraska suffered most, but the conditions were now critical from the Lake region, central Ohio Valley, and Tennessee westward to the middle Rocky Mountain region, including the greater part of Texas. Portions of the Middle and South Atlantic States continued to suffer from excessive moisture, but very favorable temperatures were experienced in these districts and also on the Pacific coast, where the week was cooler than usual. The outlook for corn was less favorable than at the close of the previous week. In Nebraska, Kansas, Oklahoma, and Missouri early corn was practically ruined, but the condition of the crop in Iowa was more favorable. In Illinois, Indiana, Ohio, Kentucky, and Tennessee, more particularly the western portions of the two last-named States, corn was seriously in need of rain. In the Middle Atlantic States the conditions were highly favorable for corn, but excessive moisture caused considerable damage to wheat in shock. Harvesting continued in the more northerly sections east of the Rocky Mountains and was in general progress on the north Pacific coast. Spring wheat harvest began over the southern portion of the spring wheat region, where, as a result of premature ripening, the yield and quality were much reduced. In portions of Mississippi, Alabama, Georgia, and Florida cotton improved, but in the two last-named States and in the Carolinas it suffered from lack of cultivation. Rain was greatly needed in Tennessee and over the western portion of the cotton belt, where, however, the crop generally withstood the drought well. Reports of fruiting at the top continued from the central and western districts, and throughout the belt the plant was small. In the Ohio Valley, Tennessee, and Wisconsin tobacco suffered much from drought, especially in western Kentucky, and was injured by rains in Maryland; elsewhere the crop made favorable progress.

July 29.—Intense heat prevailed during the greater part of this week throughout the central valleys, but the temperature during the last three days was more moderate. Good rains fell over a large part of the drought area in the Mississippi and upper Missouri valleys, but drought became more serious in the Ohio Valley and Tennessee, where the week was rainless except in a few localities. On the Pacific coast and in the Atlantic coast districts the weather was generally favorable except over portions of the Carolinas and Virginia, where rain was needed. Rains improved late corn in portions of Nebraska, Kansas, Oklahoma, and Missouri, but the early crop was practically ruined. In Iowa the crop sustained less injury than in the before-mentioned States, and the rainfall was copious and well distributed. In the great corn States east of the Mississippi River, except over northern Illinois, drought and excessive heat continued with disastrous effects upon corn, now in a critical condition. In Michigan and generally throughout the Middle Atlantic States and New England the corn crop was in fine condition. Premature ripening reduced the yield and quality of spring wheat over the southern portion of the spring-wheat region. Over the greater part of the cotton belt cotton improved, good growth and clean fields being generally reported. In Missouri, Arkansas, Tennessee, and central Texas, however, the crop continued to need rain, and shedding and blooming at top in these States were extensively reported. In the Ohio Valley and Tennessee, tobacco continued to suffer from drought, but in Kentucky and Tennessee it withstood the unfavorable conditions well, and in New England, the Middle and South Atlantic States, made good growth.

August 5.—With more moderate temperatures and good rains over a large part of the drought-stricken area, the weather conditions of the week ending August 5 were the most favorable to agricultural interests in the States of the central valleys that had obtained since the latter part of June. In the States of the Missouri Valley the severe and protracted drought was very largely relieved, but to the eastward of the Mississippi and north of the Ohio River only partial relief was afforded, the drought in the Upper Ohio Valley being more serious that at any previous date. The East Gulf and portions of the South Atlantic States and Texas also needed rain. In the Middle Atlantic States and New England and throughout the Pacific coast districts the week proved generally favorable. In the great corn States late corn experienced a general and in some cases a decided improvement, but the early corn had been practically ruined. In Kansas the cooler weather, with better distributed rains, decidedly improved conditions in the eastern and western divisions of the State, slightly benefited the central portions, and in many of the eastern, western, and south central counties late corn still promised from one-fourth to half a crop. In Nebraska the improvement was less marked and was confined largely to the northern and

extreme eastern counties. In Iowa the late-planted corn showed some improvement. In Missouri, except in portions of the southern section, late corn was much improved, but in other parts of the State it continued to deteriorate. In Illinois corn greatly improved in the northern part of the State, but deteriorated in parts of the central and southern portions. In a few favored districts of northern Indiana corn was still promising, but elsewhere the upland and early planted was almost beyond recovery. Over the greater part of Ohio the condition of corn was materially lowered, a portion of the crop in the southwest part of the State being past help. In northeastern Ohio its condition was hopeful. In Tennessee, Kentucky, and West Virginia corn was materially reduced, but in the Middle Atlantic States an excellent crop was practically assured. The weather in the spring-wheat region was very favorable for harvesting, which was nearing completion in the southern districts. Some damage resulted from hail in South Dakota. In Washington a splendid crop was promised, and in Oregon the yields were better than expected. There was a very general improvement in the condition of cotton over the greater part of the cotton belt, the least favorable reports being received from the north central and the extreme eastern districts, where shedding and rust, and in sections blooming to top, were reported. Over the southern portions of the eastern districts cotton was opening, considerable picking having been done in Texas. In the Atlantic coast districts tobacco made very favorable progress, but in the States of the Ohio Valley it made but little growth and was badly in need of rain.

August 12.—The week ending August 12 was one of very favorable temperature conditions in the districts east of the Rocky Mountains, with beneficial rains over a large part of the drought area. Drought, however, continued in the Ohio Valley and in portions of Tennessee and the Upper Lake region, while excessive rains caused destructive freshets in the Carolinas and proved injurious in portions of Georgia, Florida, and Alabama. Extremely hot weather in the interior of California caused rapid ripening of fruit and serious injury to grapes in some places. Late corn experienced material improvement in the States of the Mississippi and Missouri valleys and in Kentucky and Tennessee. In Ohio, Indiana, and central and southern Illinois there was further deterioration of the crop, especially in southwestern Ohio. In the Atlantic coast districts corn made excellent progress. Rains interrupted spring-wheat harvest, which, however, was nearly finished over the southern portion of the spring-wheat region, and caused lodging in portions of North Dakota, where the grain was reported as shrunken and the heads not well filled. Wheat harvest on the North Pacific coast was in active progress, with yields better than expected. Further improvement in the condition of cotton was generally reported from the central and eastern portions of the cotton belt, although rust and shedding were more or less reported in Georgia, Florida, and portions of Alabama. Over much of the western part of the cotton belt and in portions of the central districts cotton suffered for rain and in the drought region of Texas was failing rapidly. In the Middle Atlantic States and New England tobacco made favorable progress, except in portions of Maryland, where, on lowlands, it was injured by too much rain. In Kentucky and portions of Tennessee the crop greatly improved, but in southwestern Ohio was seriously damaged by drought.

CONDITION OF CORN, COTTON, AND TOBACCO.

August 19.—The temperatures of this week were favorable, except on the North Pacific coast, where they were unusually high. The Middle and South Atlantic and East Gulf States, including Tennessee, suffered from heavy rains, the South Atlantic and East Gulf States and Tennessee experiencing damaging winds, as well as injury from overflows. The greater part of Texas and portions of the Missouri and Upper Mississippi valleys and Upper Lake region continued to suffer from drought, which began to affect crops in Oregon and Washington. A very general improvement in the condition of late corn was indicated in the principal corn States, but the crop continued to suffer for rain over extensive areas in Nebraska, Kansas, and Missouri. Good rains in Illinois, Indiana, and Ohio improved the outlook, especially in Indiana, but, as in other portions of the corn belt, the greater part of the early corn had been ruined. The weather was favorable for spring-wheat harvest, which was nearly finished in the Dakotas, Minnesota, and Oregon. Owing to excessive heat the grain ripened somewhat too rapidly in Washington. The central and eastern portions of the cotton belt suffered from heavy rains, while drought became more serious over the greater part of the western districts. In the Carolinas too rank growth was reported, especially on stiff lands, and in Georgia, Florida, and Alabama heavy rains and high winds caused injury, rust and shedding being quite prevalent. In Tennessee, Mississippi, and portions of Arkansas the crop improved. Cotton needed rain throughout Texas, and failed rapidly in the central-southern and southwestern portions.

Tobacco sustained injury from rains in portions of Maryland, Virginia, North Carolina, and Tennessee, but was greatly benefited in the last-named State, as well as in the Ohio Valley.

August 26.—This week was generally favorable, except in the Middle and South Atlantic and East Gulf States and Tennessee, where in nearly all sections heavy rains damaged crops and interfered with work, and in some districts washed lands and caused inundations. Drought conditions still prevailed in portions of Iowa, Oklahoma, and Texas, and rain was needed in Michigan, Nebraska, the North Pacific coast States, and portions of Kansas and Missouri. Continued improvement in the condition of late corn was generally reported from the principal corn-growing States, the prospects for late corn being decidedly improved in the Ohio Valley. Spring-wheat harvest was practically finished in all sections, although retarded some by rain in South Dakota and Minnesota. This week was generally unfavorable for cotton, complaints of rust and shedding being general throughout the entire cotton belt, except in Missouri and Oklahoma, while in Oklahoma the crop was somewhat damaged by hot, dry weather. Some favorable reports were, however, received from Tennessee, Arkansas, and Louisiana. Cotton was backward and in poor condition in Texas, although the late planted improved where rain fell.

September 2.—While the weather conditions of this week were generally favorable heavy rains injured crops and retarded work in portions of the South Atlantic and Gulf States, and dry, hot weather was unfavorable in the Missouri and Upper Mississippi valleys and on the North Pacific coast. Extreme heat and drought in localities in Oklahoma and Texas were also very detrimental to crops. Generally this week was unfavorable for cotton. Continued reports of rust and shedding were received from the greater portion of the eastern and central section of the cotton belt, premature opening being reported from Arkansas and Oklahoma. In Texas the late cotton suffered marked deterioration.

MATURING AND GATHERING OF FALL CROPS.

September 9.—This week was generally favorable for gathering and maturing late crops in nearly all sections east of the Rocky Mountains and on the Pacific slope. Rains retarded work in Nebraska and South Dakota, and caused some damage to crops in the first-named State, while drought conditions continued in portions of Texas and Oklahoma and in the central valleys. Light frosts were quite general in the Rocky Mountain region and in Michigan, with little or no damage, and snow occurred in Montana. Conditions were particularly favorable in the South Atlantic and Gulf districts. In the principal corn States west of the Mississippi River late corn matured rapidly, and cutting was in active progress, being nearly completed in some localities. Generally favorable reports were received from States east of the Mississippi River, with the exception of Illinois, where corn deteriorated slightly. This week was more favorable for cotton, which opened rapidly in all sections, picking being in general progress. Complaints of rust and shedding still continued, however, from the eastern and central districts of the cotton belt. No improvement was noted in late cotton in Texas, where it had stopped growing and blooming in the drought-stricken districts, and was shedding and rusting badly where rain fell.

September 16.—Heavy rains of this week proved unfavorable in the central and west Gulf States, and in portions of the Ohio Valley, Tennessee, and the Upper Missouri Valley, while crops suffered from drought in the south Atlantic coast districts. East of the Rocky Mountains the temperature conditions were favorable, except in the upper Missouri Valley, where it was too cool, and frosts were of quite general occurrence in the Plateau region. Generally favorable conditions prevailed in the Pacific Coast States. Cool, wet weather checked the maturing of corn in Nebraska and South Dakota, but in the central and eastern districts of the corn belt the crop was practically safe from frost, cutting being well advanced. Excessive rains in the central and western portions of the cotton belt caused serious injury to cotton and interfered with picking; over the eastern half of the cotton belt the rainfall being moderate, or very light, the coast districts receiving no appreciable amount. Cotton opened freely, and picking progressed rapidly. Reports of rust and shedding continued from the central and eastern districts. Except in Kentucky, where heavy rains interfered with cutting tobacco, the crop was largely secured. The abundant rains in the central valleys put the soil in excellent condition for plowing, and this work was being rapidly pushed, though retarded by excessive moisture in some districts. Considerable seeding was done.

September 23.—This week was unseasonably cool in nearly all districts east of the Rocky Mountains, with light to heavy frosts, more or less damaging, throughout the central valleys, Middle Atlantic States, and northern portions of the Central Gulf

States. Excessively heavy and damaging rains occurred in the East Gulf and South Atlantic States. On the Pacific coast the weather conditions were very favorable, except in northern and portions of central California, where rains caused damage to grain, hay, and grapes. Late corn was damaged to some extent by heavy frosts in North Dakota and portions of Nebraska, Kansas, Missouri, and Iowa. Late corn also suffered some slight damage on low lands in Indiana and Ohio, but the bulk of the crop east of the Mississippi River was matured and safe from injury prior to the occurrence of these frosts. The heavy rains in the South Atlantic and East Gulf States caused much injury to cotton, and the reports from the central and western districts of the cotton belt continued to show the unfavorable effects of the rains of the previous week, although a large part of the last-named districts received only light showers, or no appreciable rainfall. In the central and eastern districts much open cotton was discolored and considerable beaten out, while rotting and sprouting were quite generally reported. During the early part of the week picking was retarded in the eastern districts, but was actively resumed at the close of the week. In Texas picking progressed uninterruptedly, and in localities some improvement in late cotton was indicated, but the general condition of the crop in that State was poor. But little damage was done by frost to tobacco in the Ohio Valley, and none elsewhere. In the Middle Atlantic States and New England the crop was housed in good condition.

September 30.—The temperature conditions of this week were highly favorable throughout the central valleys, lake region, Middle Atlantic States, and New England, and no damaging frosts occurred in these districts. Heavy rains in the Upper Missouri Valley and Minnesota interfered with farm work and caused some damage to hay and stacked grain in South Dakota and Nebraska. Excessive rains also interfered with farm work in portions of the South Atlantic and East Gulf States. Rain was generally needed in Illinois, Indiana, and southern Michigan to put the soil in condition for plowing for fall seeding, and also over the greater part of Texas for pastures and truck farms. On the North Pacific coast the week was cool and wet, damaging frosts occurring in Oregon and Washington. Injurious frosts also occurred over the middle Rocky Mountain districts. The week was favorable for maturing and gathering corn. The weather conditions in the cotton belt were very favorable for cotton picking, except over portions of Georgia, Florida, and North Carolina, where this work was retarded to some extent by rains of the latter part of the week. Picking progressed rapidly in the central and western districts, where cotton opened rapidly, the bulk of the crop being gathered in some places. Over the eastern portion of the cotton belt the low temperatures were not favorable for the development of the top crop and heavy rains damaged the staple in portions of North Carolina, Georgia, and Florida, while the sea island crop of South Carolina suffered from drought. In Texas late cotton was damaged by boll weevil and other insects. Only a small part of the tobacco crop, and that in Kentucky and Tennessee, remained unhoused, and the reports generally indicated that the crop had been secured in satisfactory condition. Plowing and seeding progressed favorably in nearly all districts, and the early sown wheat in the States of the lower Missouri Valley came up in excellent condition. In southern Michigan and portions of the Ohio and central Mississippi valleys, however, plowing and seeding were delayed on account of the dry condition of the soil, and in Ohio seeding was purposely delayed on account of the Hessian fly.

October.—This month was very mild, and for the most part drier than usual, the weather conditions being generally favorable for farming operations. At the close of the month rain was very generally needed over the middle, South Atlantic, and Gulf districts, and also in the central valleys and middle Rocky Mountain region, drought being very severe in western Texas and the upper Ohio Valley. Very little damage by frost occurred. On the Pacific coast the month was favorable, except in California, where rains caused some damage. The conditions were very favorable for gathering and husking corn. In Nebraska, Kansas, and Iowa fall grain made vigorous growth, but it needed rain over limited areas in the two last-named States. In Missouri, Illinois, Ohio, and Kentucky germination and growth of fall-sown grain was checked by absence of moisture, but in Indiana and Michigan the condition of the crop was very promising. Practically the whole month was favorable for cotton picking, and except over limited areas the bulk of the crop was gathered by the close of the month.

Average daily temperature departures (degrees Fahrenheit) for season of 1901 from normal based upon observations for many years, by sections.

Sections.	From Jan. 1 to Apr. 1, inclusive.	For weeks ended—											
		April—				May—				June—			
		8.	15.	22.	29.	6.	13.	20.	27.	3.	10.	17.	24.
Middle and South Atlantic States	−1.3	−2.8	−2.8	−5.2	−5.3	+ 3.2	+1.3	+0.6	−0.8	−6.4	−1.2	−0.8	−1.3
Gulf States	+1.2	−5.6	−3.9	−8.3	0.0	+ 4.3	+1.2	+3.3	−4.4	−4.8	+0.8	+1.3	+3.2
Ohio Valley and Tennessee	−1.0	−6.6	−3.6	−9.6	−2.1	+ 8.8	−1.5	0.0	−5.0	−9.4	−2.4	+1.5	+2.4
Lake region	−1.1	+0.4	+1.2	−2.8	+5.6	+ 6.8	+1.6	−0.6	−2.6	−7.1	−3.6	+2.0	+1.1
Upper Mississippi and Missouri valleys	+1.4	−5.0	−0.7	−7.2	+8.1	+13.7	−4.0	+5.5	−4.8	−1.2	−1.8	+2.5	+3.5
Rocky Mountain region	+1.3	−5.5	−3.5	−2.6	+5.1	+ 3.7	+2.8	+4.8	−2.0	−0.6	−0.9	−3.7	+2.2
North Pacific coast	+0.5	−7.3	+0.3	0.0	−3.3	− 1.0	+3.0	−1.7	−0.3	−1.0	−7.0	−2.3	+1.3
California	+1.3	−5.4	+1.8	−0.4	−2.6	− 3.3	+2.6	−2.0	−5.2	+0.4	−1.6	−1.6	−2.2

Sections.	For weeks ended—													
	July—					August—				September—				
	1.	8.	15.	22.	29.	5.	12.	19.	26.	2.	9.	16.	23.	30.
Middle and South Atlantic States	+4.3	+4.1	−1.1	+ 1.6	+2.2	+1.8	+0.6	+1.9	+2.2	+1.2	+0.9	+5.3	−4.3	+1.5
Gulf States	+2.2	+2.2	+3.1	+ 1.2	+0.7	+1.9	+1.4	+1.4	+1.2	+2.8	+1.0	+3.0	−7.5	+1.6
Ohio Valley and Tennessee	+7.1	+3.8	+0.6	+ 5.5	+8.4	+2.0	+1.2	0.0	+2.1	+1.2	+1.5	+3.5	− 8.1	+4.6
Lake region	+8.1	+3.4	+1.0	+ 8.8	+3.8	+0.2	−1.5	+4.2	+3.8	+2.9	+3.5	+2.0	−5.5	+5.0
Upper Mississippi and Missouri valleys	+8.8	+4.6	+8.2	+10.5	+9.5	+1.6	+0.3	+2.5	+5.4	+3.5	+4.5	+0.5	−8.6	+7.0
Rocky Mountain region	+1.0	+2.5	+3.7	+ 5.2	+3.1	+1.8	+2.1	+2.4	+3.8	+5.5	+0.2	0.0	−2.8	+1.2
North Pacific coast	− 5.7	−4.0	−4.0	− 1.0	− 3.0	+3.3	+3.0	+5.3	−0.7	−0.7	−4.3	−1.0	+3.0	−3.3
California	+2.4	−2.4	−1.2	− 0.8	+0.6	+4.2	+1.4	−0.4	−3.0	−2.6	−2.2	0.0	−2.4	−4.6

Average daily temperature departures (degrees Fahrenheit) for season of 1901 from normal based upon observations for many years, by stations.

Stations.	From Jan. 1 to Apr. 1, inclusive.	For weeks ended— April— 8.	15.	22.	29.	May— 6.	13.	20.	27.	June— 3.	10.	17.	24.
New England:													
Eastport, Me.	-0.6	+4	+3	+2	+1	0	-1	+1	+2	-3	0	+3	0
Portland, Me	-1.8	+1	+1	-3	-2	-1	-1	-1	-1	-9	+1	-1	-5
Boston, Mass.	-0.4	+1	0	-5	-4	-1	+1	0	-3	-9	+3	-1	-1
Middle Atlantic States:													
Albany, N. Y	-0.9	+3	+1	+3	+4	+3	+4	-1	-1	-6	-2	-3	+2
New York City	-1.0	+1	+2	-2	+1	+5	+1	+1	-2	-6	+1	+1	+1
Philadelphia, Pa	-0.6	-1	-1	-3	-1	+3	-1	0	-4	-6	-1	-1	0
Washington, D. C	-0.2	-3	-3	-4	-3	+5	0	-1	-4	-6	-3	-2	-2
Lynchburg, Va	-0.4	-3	-4	-6	-6	+4	-1	0	-2	-6	-3	0	-2
Norfolk, Va.	-0.4	-1	-4	-4	-8	+3	-1	-3	-2	-3	-2	+2	-5
South Atlantic States:													
Charlotte, N. C.	-1.3	-7	-4	-6	-10	+6	+1	+1	+1	-8	0	0	-3
Wilmington, N. C.	-2.4	-3	-4	-7	-9	+1	+2	+2	+1	-3	0	+1	-4
Charleston, S. C.	-1.8	-3	-3	-8	-8	+2	+3	+1	0	-7	0	-2	-3
Augusta, Ga.	-2.0	-9	-6	-9	-10	+3	+2	+3	+1	-10	-2	-1	0
Savannah, Ga	-1.8	-4	-3	-8	-8	+3	+4	+2	+1	-8	-1	-2	0
Jacksonville, Fla	-2.8	-2	-3	-8	-8	+1	+2	+2	+1	-8	-2	-2	0
Gulf States:													
Atlanta, Ga.	-1.7	-9	-4	-10	-7	+8	+1	+5	-3	-8	+1	-1	+3
Mobile, Ala.	-1.3	-4	-1	-8	-3	+3	+4	+3	-4	-6	-2	0	+3
Montgomery, Ala.	-1.9	-7	-3	-10	-4	+6	0	+4	-4	-9	-2	-1	+3
Vicksburg, Miss	-0.4	-5	-3	-9	+1	+4	0	+3	-8	-5	0	+3	+3
New Orleans, La	-0.9	-2	-3	-8	0	+3	+2	+3	-3	-3	+1	+1	+4
Shreveport, La	+0.3	-7	-7	-8	+3	+4	+1	+1	-7	-5	+2	+3	+3
Fort Smith, Ark	+3.3	-8	-6	-8	+6	+6	+1	+5	-3	-2	+4	+4	+3
Little Rock, Ark.	+0.6	-8	-4	-9	+3	+7	-2	+3	-5	-4	+1	+3	+4
Palestine, Tex	+1.8	-6	-7	-7	+2	+3	+2	+4	-4	-6	+2	+1	+3
Galveston, Tex	+0.5	-3	-3	-8	-1	+1	+1	0	-4	-4	0	-1	+2
San Antonio, Tex.	+1.0	-3	-2	-6	+1	+2	+3	+5	-3	-1	+4	+2	+4
Ohio Valley and Tennessee:													
Memphis, Tenn.	+1.1	-8	-2	-8	+2	+10	-3	0	-7	-7	+1	+1	+3
Nashville, Tenn	-0.9	-9	-4	-12	-4	+9	-2	0	-7	-10	0	+1	+4
Chattanooga, Tenn	-2.0	-8	-5	-11	-6	+7	-1	+3	-2	-9	0	-1	+4
Louisville, Ky	-0.7	-8	-5	-11	-4	+11	-3	+1	-7	-10	-5	+1	+3
Indianapolis, Ind.	-1.0	-6	-3	-10	+1	+11	-5	-1	-7	-11	-4	+3	+1
Cincinnati, Ohio.	-2.3	-6	-4	-10	-3	+10	-2	-1	-6	-11	-4	+2	+2
Columbus, Ohio	-1.2	-4	-3	-9	-3	+6	+1	0	-3	-8	-3	+4	+1
Pittsburg, Pa	-1.1	-4	-3	-6	0	+6	+3	-1	-1	-9	-4	+1	+1
Lake region:													
Oswego, N. Y	-2.2	0	-1	+3	+4	+1	+6	-3	-1	-5	-4	0	0
Buffalo, N. Y.	-0.4	+1	+3	+1	+8	+3	+7	-1	-1	-9	-5	+3	+2

Average daily temperature departures (degrees Fahrenheit) for season of 1901 from normal based upon observations for many years, by stations—Cont'd.

Stations.	From Jan. 1 to Apr. 1, inclusive.	For weeks ended— April— 8.	15.	22.	20.	May— 6.	13.	20.	27.	June— 3.	10.	17.	21.
Lake region—Continued.													
Cleveland, Ohio	−0.8	−2	−2	−4	0	+4	+2	−4	−2	−12	−5	+1	+1
Detroit, Mich	−2.6	0	+1	−3	+6	+10	+1	−1	−4	−10	−4	+2	+2
Grand Haven, Mich	−1.4	+2	+2	−5	+6	+11	+1	0	−3	−11	−3	+6	−1
Milwaukee, Wis	+0.3	+2	+4	−3	+7	+13	0	+3	−5	−4	−2	+3	+3
Chicago, Ill	−2.2	−3	−2	−6	+4	+12	−4	−3	−5	−9	−2	+4	+1
Duluth, Minn	+0.1	+3	+5	−5	+10	0	0	+4	0	+8	−4	−3	0
Upper Mississippi Valley:													
St. Paul, Minn	+1.7	+2	+6	−8	+14	+19	−3	+7	−5	0	−5	+5	+1
La Crosse, Wis	+0.2	+3	+3	−6	+13	+18	−1	+5	−7	−3	−5	+3	0
Davenport, Iowa	−0.4	−1	0	−7	+6	+16	−2	+3	−6	−4	−3	+7	+2
Des Moines, Iowa	+2.3	−4	−1	−8	+9	+11	−5	+6	−5	0	−3	+3	+3
Springfield, Ill	+0.2	−5	−3	−9	+3	+12	−5	+3	−4	−4	−3	+4	+5
Cairo, Ill	−0.1	−8	−2	−10	0	+10	−5	+2	−5	−6	−1	+2	+5
St. Louis, Mo	+1.5	−8	0	−7	+4	+15	−5	+4	−5	−4	−3	+6	+8
Missouri Valley:													
Springfield, Mo	+1.1	−11	−2	−10	+5	+9	−4	+6	−5	−1	+5	+2	+6
Kansas City, Mo	+2.3	−7	−2	−7	+9	+11	−6	+4	−6	0	+2	+6	+5
Concordia, Kans	+1.5	−10	−7	−8	+7	+8	−3	+4	−5	−1	+2	0	+4
Omaha, Nebr	+2.7	−5	0	−7	+10	+14	−7	+6	−5	0	−3	+2	+1
Valentine, Nebr	+3.1	−7	−3	−2	+12	+16	−2	+11	−3	+3	−3	−6	+2
Huron, S. Dak	+7.0	−3	+2	−5	+13	+16	−4	+11	−1	+5	−4	−2	+3
Extreme Northwest:													
Moorhead, Minn	+7.0	+5	+7	−6	+11	+17	−5	+12	+3	+6	−9	0	+1
Bismarck, N. Dak	+5.8	+4	+4	−4	+9	+16	−4	+14	+2	+10	−6	−4	0
Williston, N. Dak	+5.1	+3	+2	−3	+3	+13	−1	+22	+8	+13	−11	−7	0
Rocky Mountain slope:													
Havre, Mont	+5.1	−2	+2	−1	−1	+10	+1	+11	−1	+7	−8	−7	−1
Helena, Mont	+3.0	−5	−1	+2	−1	+7	+4	+9	−1	+2	−8	−7	+2
Spokane, Wash	+3.6	−9	0	−1	−2	+2	+2	−1	+1	−1	−10	−7	+2
Salt Lake City, Utah	+1.9	−10	0	+1	+7	+2	+8	+10	+4	+1	−2	−8	+5
Cheyenne, Wyo	−0.4	−3	−7	−4	+9	+7	+1	+7	−3	+2	−1	−8	−1
North Platte, Nebr	+1.7	−7	−3	−5	+11	+8	+2	+7	−5	+2	−2	−3	+3
Denver, Colo	+0.4	−2	−9	−3	+10	+7	+4	+6	−1	+1	+1	−5	+1
Dodge, Kans	+1.9	−6	−5	−5	+10	+5	−1	+2	−6	−2	+5	+1	+3
Oklahoma, Okla	−0.5	−5	−8	−7	+5	+3	+2	0	−4	−4	+4	+3	+4
Abilene, Tex	+1.7	−4	−7	−5	+4	0	+2	+2	−6	−7	+7	+2	+6
Santa Fe, N. Mex	+1.0	−5	+1	−2	+6	−1	+3	+2	−1	−4	+2	−5	+3
El Paso, Tex	+0.4	−7	−4	−4	+4	0	+2	+3	−1	−5	0	−4	+1
Phoenix, Ariz	+1.7	−7	−4	0	+4	−2	+4	+4	−2	−2	+1	−5	+1

Pacific coast:													
Seattle, Wash	+0.6	−6	0	−1	−2	−1	+2	−1	+1	+1	−6	−3	+1
Portland, Oreg	+0.7	−8	0	0	−4	−1	+2	−2	0	−2	−8	−3	+2
Roseburg, Oreg	+0.1	−8	+1	+1	−4	−1	+5	−2	−2	−2	−7	−1	+1
Red Bluff, Cal	−0.4	−8	+7	+1	−5	−1	+9	−2	−9	+3	−1	−2	−1
Sacramento, Cal	+0.3	−9	+4	+2	−3	−4	+4	−3	−8	+2	−1	+1	−3
San Francisco, Cal	+0.8	−5	0	−3	−3	−4	−2	−4	−3	0	−3	−3	−4
Los Angeles, Cal	+2.8	−4	−1	−1	−1	−2	+1	−1	−3	−2	−2	−2	−1
San Diego, Cal	+3.2	−1	−1	−1	−1	+1	+1	0	−3	−1	−1	−2	−2

Stations.	For weeks ended—													
	July—					August—				September—				
	1.	8.	15.	22.	29.	5.	12.	19.	26.	2.	9.	16.	23.	30.
New England:														
Eastport, Me	+7	+3	+2	+4	+1	−3	+2	+3	+1	+4	+4	+2	−1	+1
Portland, Me	+10	0	−1	+7	0	−2	−1	+1	+1	+2	+5	+3	−1	+1
Boston, Mass	+10	+3	0	+7	−1	+1	+1	+2	+1	+2	+4	+7	0	+3
Middle Atlantic States:														
Albany, N. Y	+10	+5	+1	+7	0	+1	−1	+3	+7	+4	+5	+4	−3	+3
New York City	+11	+9	0	+7	+3	+4	+2	+4	+5	+4	+4	+6	−2	+4
Philadelphia, Pa	+9	+10	−2	+4	0	+4	+3	+3	+5	+2	+3	+7	−3	+3
Washington, D. C	+6	+7	−2	+3	+3	+3	0	+3	+4	+1	−1	+5	−6	0
Lynchburg, Va	+4	+4	−2	+1	+5	+2	−1	+1	+2	−1	0	+4	−8	−1
Norfolk, Va	+3	+7	−3	+1	+4	+3	+2	+3	+3	+1	+2	+6	−3	+2
South Atlantic States:														
Charlotte, N. C	+3	+4	−2	0	+5	+3	+1	+2	0	+1	−1	+5	−8	+1
Wilmington, N. C	0	+3	−4	−2	+3	0	+1	+2	−1	+1	0	+6	−5	+2
Charleston, S. C	0	−1	−2	−1	+1	0	0	+1	0	+1	0	+6	−3	+1
Augusta, Ga	+3	+1	+1	−1	+2	+1	0	+1	0	0	−1	+5	−5	+2
Savannah, Ga	+2	0	−1	−2	+1	0	0	+1	−1	0	+1	+6	−4	+1
Jacksonville, Fla	+1	0	+1	+1	0	+1	0	−1	0	0	−1	+4	−2	0
Gulf States														
Atlanta, Ga	+3	+2	+2	0	+4	+2	+1	−1	−2	0	+1	+4	−9	−1
Mobile, Ala	+1	0	+5	0	0	+1	0	0	0	0	+1	+4	−6	−1
Montgomery, Ala	+4	0	+4	0	+3	+2	+1	0	0	0	−1	+5	−7	−3
Vicksburg, Miss	+2	+2	+4	−1	−2	+2	+1	0	0	+2	+1	+2	−9	+2
New Orleans, La	+2	0	+6	−1	−1	+2	+2	0	−1	+1	+2	+3	−6	0
Shreveport, La	+2	+2	+4	+3	−1	+2	+1	+2	+1	+3	+1	+1	−8	+3
Fort Smith, Ark	+5	+7	+6	+6	+3	+4	+1	+2	+7	+9	+3	+3	−8	+3
Little Rock, Ark	+5	+5	+3	+5	+3	+3	+1	+1	+1	+5	+2	+3	−9	+4
Palestine, Tex	+1	+3	+3	+2	0	+1	+2	+3	+3	+6	+2	0	−9	+3
Galveston, Tex	0	0	0	−1	−1	+1	+2	+3	+2	0	−2	+2	−6	+1
San Antonio, Tex	−1	+3	0	+1	0	+1	+3	+5	+3	+5	+1	+6	−5	+2
Ohio Valley and Tennessee:														
Memphis, Tenn	+6	+3	+2	+5	+5	+4	+1	−4	+2	+1	+2	+1	−10	+5
Nashville, Tenn	+5	+3	+1	+5	+8	+2	+1	−5	0	−1	0	+4	−9	+3
Chattanooga, Tenn	+5	+5	+2	+2	+6	+4	+1	−2	−1	0	0	+3	−7	−1

Average daily temperature departures (degrees Fahrenheit) for season of 1901 from normal based upon observations for many years, by stations—Cont'd.

Stations.	For weeks ended—													
	July—					August—				September—				
	1.	8.	15.	22.	29.	5.	12.	19.	26.	2.	9.	16.	23.	30.
Ohio Valley and Tennessee—Continued.														
Louisville, Ky	+ 8	+ 4	0	+ 7	+11	+2	+1	0	+3	+1	+2	+3	− 8	+ 6
Indianapolis, Ind	+ 7	+ 3	+ 1	+ 8	+11	+1	+1	+3	+2	+2	+3	+4	− 8	+ 9
Cincinnati, Ohio	+ 8	+ 3	0	+ 7	+10	+1	+2	+2	+2	+2	+1	+5	− 8	+ 5
Columbus, Ohio	+10	+ 5	− 1	+ 6	+ 9	+1	+2	+2	+4	+3	+3	+2	− 9	+ 6
Pittsburg, Pa	+ 8	+ 4	0	+ 4	+ 7	+1	+1	+1	+5	+2	+1	+3	− 6	+ 4
Lake region:														
Oswego, N. Y	+ 9	+ 4	+ 2	+ 8	+ 1	−1	−3	+1	+5	+ 4	+2	+2	− 3	+ 2
Buffalo, N. Y	+ 7	+ 5	+ 2	+ 7	+ 2	0	−2	+5	+7	+ 5	+4	+5	− 4	+ 4
Cleveland, Ohio	+ 8	+ 5	0	+ 6	+ 6	+1	+1	+2	+3	+ 2	+1	+2	− 5	+ 5
Detroit, Mich	+ 8	+ 1	+ 1	+ 9	+ 6	−1	−1	+5	+5	+ 4	+5	+3	− 6	+ 7
Grand Haven, Mich	+ 9	+ 3	+ 2	+10	+ 7	−1	−4	+5	+2	+ 2	+2	+1	− 6	+ 5
Milwaukee, Wis	+11	+ 5	+ 1	+10	+ 7	+2	−1	+6	+3	+ 4	+5	+1	− 6	+ 7
Chicago, Ill	+11	+ 5	+ 1	+ 9	+ 7	+1	−1	+3	+1	0	+3	−1	− 9	+ 8
Duluth, Minn	+ 2	− 4	− 1	+11	− 6	+1	−1	+8	+4	+ 2	+6	+3	− 5	+ 2
Upper Mississippi Valley:														
St Paul, Minn	+ 8	+ 1	+ 7	+13	+ 7	−1	−1	+6	+7	+ 1	+5	−1	− 7	+ 4
La Crosse, Wis	+10	+ 1	+ 6	+12	+ 9	−1	−1	+2	+6	+ 2	+4	−4	− 8	+ 5
Davenport, Iowa	+ 9	+ 4	+ 6	+12	+12	0	−2	+4	+3	+ 1	+6	−2	−10	+10
Des Moines, Iowa	+10	+ 5	+11	+13	+12	+2	0	+4	+7	+ 3	+6	−1	−10	+ 8
Springfield, Ill	+ 8	+ 5	+ 4	+ 9	+10	+1	+2	+3	+2	+ 2	+5	+3	−12	+ 8
Cairo, Ill	+ 8	+ 3	+ 3	+ 6	+ 8	+1	0	−3	+1	0	+3	+5	− 8	+ 6
St Louis, Mo	+12	+ 7	+ 6	+10	+13	+5	+2	+2	+5	+ 3	+5	+6	− 9	+ 9
Missouri Valley:														
Springfield, Mo	+ 8	+ 9	+10	+ 9	+ 7	+5	+1	+1	+8	+ 7	+6	+2	−12	+11
Kansas City, Mo	+12	+ 8	+11	+12	+10	+3	+1	+3	+5	+ 5	+6	+2	−11	+ 9
Concordia, Kans	+13	+ 8	+11	+ 9	+ 9	+5	+1	+3	+9	+ 6	+4	−1	−12	+ 7
Omaha, Nebr	+12	+ 3	+10	+13	+12	+1	0	+2	+5	+ 5	+5	−1	− 9	+ 8
Valentine, Nebr	+ 2	+ 3	+ 9	+ 9	+ 7	−1	+1	+1	+6	+ 5	0	−1	− 9	+ 3
Huron, S. Dak	+ 3	+ 3	+12	+ 9	+ 8	+2	0	+5	+6	+ 6	+3	−3	− 8	+ 3
Extreme northwest:														
Moorhead, Minn	+ 2	+ 1	+ 8	+ 7	+ 4	+1	−1	+6	+4	+ 5	+4	+1	− 6	− 2
Bismarck, N. Dak	0	+ 1	+ 6	+ 7	+ 3	−2	−1	+6	+2	+ 7	+3	−1	− 9	− 3
Williston, N. Dak	− 4	0	+ 6	+ 6	+ 3	0	−3	+4	+1	+ 8	+3	0	− 9	− 9
Rocky Mountain slope:														
Havre, Mont	− 9	0	+ 4	+ 6	+ 4	0	+3	+6	+2	+10	−3	−2	− 5	− 9
Helena, Mont	−11	0	+ 2	+ 6	+ 5	+3	+2	+5	+2	+ 5	−8	−5	− 6	− 8
Spokane, Wash	− 8	− 2	− 4	− 1	0	0	+3	+7	+5	+ 3	−6	−2	+ 1	− 5
Salt Lake City, Utah	− 4	+ 1	+ 5	+ 7	+ 5	+4	0	0	+2	+ 5	0	−3	+ 1	− 4
Cheyenne, Wyo	+ 5	+ 2	+ 6	+ 5	+ 4	+2	+2	+3	+3	+ 4	+3	−1	− 3	+ 1
North Platte, Nebr	+10	+ 6	+10	+ 9	+ 8	+1	+2	+1	+6	+ 4	+2	−1	− 6	+ 4
Denver, Colo	+ 6	+ 3	+ 6	+ 6	+ 5	+4	+2	+3	+3	+ 5	+4	+2	− 4	+ 1
Dodge City, Kans	+ 8	+ 5	+ 8	+ 7	+ 6	+1	+2	+1	+7	+ 4	+5	+3	− 6	+ 7

Oklahoma, Okla	+ 8	+ 7	+ 8	+ 8	+ 2	+8	+1	+1	+8	+ 6	+1	+1	− 9	+ 7
Abilene, Tex	+ 3	+ 5	+ 1	+ 1	0	+3	+3	+2	+5	+ 9	0	+3	− 5	+ 9
Santa Fe, N. Mex	+ 5	+ 3	+ 2	+ 1	0	+1	+2	+1	+5	+ 5	+2	0	− 1	+ 6
El Paso, Tex	+ 2	− 1	− 1	− 1	− 1	+1	+3	+1	+3	+ 7	+3	+2	+ 1	+ 7
Phoenix, Ariz	+ 3	+ 3	+ 6	+ 4	+ 2	+1	+2	0	+4	+ 4	0	+2	+ 5	− 1
Pacific coast:														
Seattle, Wash	− 6	− 2	− 5	− 1	− 3	+1	+1	+4	0	0	−3	0	+ 4	− 2
Portland, Oreg	− 6	− 5	− 4	− 2	− 4	+4	+3	+5	0	− 1	−5	−3	+ 3	− 4
Roseburg, Oreg	− 5	− 5	− 3	0	− 2	+5	+5	+7	−2	− 1	−5	0	+ 2	− 4
Red Bluff, Cal	+ 2	− 3	− 2	− 1	+ 4	+8	+5	+2	−8	− 3	−2	+4	− 1	− 9
Sacramento, Cal	+ 4	− 2	− 1	− 1	+ 2	+7	+4	−1	−6	− 3	−2	+4	− 3	− 6
San Francisco, Cal	+ 2	− 3	− 4	− 2	− 3	0	−1	−2	−2	− 4	−1	−1	− 4	− 2
Los Angeles, Cal	+ 4	− 2	+ 2	+ 2	+ 1	+4	0	0	+1	− 1	−4	−4	− 3	− 4
San Diego, Cal	0	− 2	− 1	− 2	− 1	+2	−1	−1	0	− 2	−2	−3	− 1	− 2

Precipitation departures (inches and hundredths) for the season of 1901 from normal based upon observations for many years, by sections.

Sections.	From Jan. 1 to Apr. 1 inclusive.	For weeks ended—											
		April—				May—				June—			
		8.	15.	22.	29.	6.	13.	20.	27.	3.	10.	17.	24.
Middle and South Atlantic States	−2.16	+1.00	−0.08	+0.62	−0.85	−0.67	+0.11	+0.10	+1.07	+0.20	−0.14	+1.41	−0.23
Gulf States	−3.55	− .61	+ .59	+1.26	− .97	− .96	− .69	− .46	+ .67	+ .39	− .14	− .95	− .98
Ohio Valley and Tennessee	−5.09	+ .15	− .36	+ .94	− .81	− .75	− .22	+ .10	+ .47	− .36	− .15	− .47	+ .23
Lake region	− .53	− .02	− .49	+ .40	− .46	− .40	− .20	− .58	+ .09	− .19	− .50	− .24	+ .16
Upper Mississippi and Missouri valleys	− .87	+ .09	− .16	− .15	− .74	− .41	− .61	− .28	− .36	− .87	+ .28	+ .17	− .24
Rocky Mountain region	− .34	− .12	+ .50	− .14	− .17	+ .11	− .34	+ .29	+ .04	+ .11	− .16	+ .31	− .25
North Pacific coast	+ .41	+1.16	− .67	− .32	+ .08	− .16	− .18	+ .45	− .20	− .30	− .20	− .21	− .17
California	+ .26	− .27	− .42	− .38	+ .40	+ .39	− .21	− .15	+ .21	− .06	− .07	− .06	− .03

Sections.	For weeks ended—													
	July—					August—				September—				
	1.	8.	15.	22.	29.	5.	12.	19.	26.	2.	9.	16.	23.	30.
Middle and South Atlantic States	−0.86	−0.04	+0.75	+0.01	−0.91	−0.66	+1.00	+0.80	+0.34	+0.14	−0.92	−0.77	+0.75	+0.07
Gulf states	− .22	− .45	− .68	+ .33	+ .70	− .02	+ .21	+ .40	+ .43	− .28	− .68	+1.69	− .09	− .14
Ohio Valley and Tennessee	− .62	− .42	− .90	− .33	− .69	− .18	− .62	+1.78	+ .63	− .38	− .79	+ .87	− .01	− .16
Lake region	+ .02	+ .92	− .64	− .46	+ .86	− .56	− .07	− .01	+ .45	+ .42	− .67	+ .85	− .48	− .16
Upper Mississippi and Missouri valleys	− .22	− .15	− .82	− .58	+ .14	− .02	− .09	− .29	− .28	− .57	+ .34	+ .97	− .45	+ .17
Rocky Mountain region	− .30	− .26	− .23	− .41	− .07	− .04	+ .01	− .20	− .15	− .14	+ .42	+ .01	− .24	+ .03
North Pacific coast	+ .25	− .09	− .13	− .01	− .06	− .07	+ .10	− .11	− .01	+ .19	− .11	− .12	+1.03	+ .65
California	− .02	− .01	.00	.00	.00	+ .01	− .01	.00	.00	− .02	− .03	− .05	+ .87	+ .09

Precipitation departures (inches and hundredths) for the season of 1901 from normal based upon observations for many years, by stations.

Stations.	From Jan. 1 to Apr. 1, inclusive.	For weeks ended— April— 8.	15.	22.	29.	May— 6.	13.	20.	27.	June— 3.	10.	17.	24.
New England:													
Eastport, Me	-0.76	+2.96	-0.53	-0.55	+0.75	0.39	+0.21	-0.66	-0.41	+0.47	+0.61	-0.57	+2.71
Portland, Me	+ .94	+3.85	- .36	+ .98	+ .13	- .46	+1.31	+2.15	+ .13	+ .18	- .31	.77	- .19
Boston, Mass	- 3.03	+1.85	- .50	+ .32	+2.47	+ .29	+ .16	+1.70	+ .34	- .11	- .34	- .70	+ .01
Middle Atlantic States:													
Albany, N. Y	-2.00	+1.36	- .38	+1.31	+ .01	- .03	+ .31	+ .61	- .29	+ .82	+ .55	- .72	+ .26
New York City	- 3.84	+1.72	- .76	+2.13	+ .58	- .40	+2.31	- .25	+ .87	+1.16	- .21	- .59	- .67
Philadelphia, Pa	- 3.22	+1.54	- .58	+ .40	+ .61	.46	+1.47	- .46	- .10	+ .07	- .23	- .12	- .53
Washington, D. C	-4.97	+1.91	+1.08	+ .85	- .11	- .80	- .17	- .91	- .31	+ .30	- .39	+2.76	- .57
Lynchburg, Va	- 3.23	+1.55	+ .71	+1.39	- .80	- .81	- .09	- .57	+2.79	- .31	+ .03	+1.69	+ .09
Norfolk, Va	- 5.93	+1.88	+ .20	- .57	- .41	- .91	- .72	- .04	+ .23	- .81	+2.10	- .42	- .85
South Atlantic States:													
Charlotte, N. C	-4.63	+2.21	+ .26	+2.03	- .54	- .90	+ .23	- .08	+3.90	- .04	- .95	+3.21	+ .31
Wilmington, N. C	-1.52	+ .87	+ .22	- .57	- .75	- .81	+ .53	+ .51	+1.76	- .58	-1.21	+ .61	+3.56
Charleston, S. C	-3.16	- .09	- .64	- .13	- .84	- .84	- .82	+ .12	+ .97	+ .25	- .81	+1.82	-1.09
Augusta, Ga	+ .00	+ .59	+ .08	+ .67	- .59	- .71	- .62	+1.43	+1.25	.00	+ .54	+ .98	-1.09
Savannah, Ga	- .08	- .88	- .51	+ .28	- .71	- .52	- .46	- .11	+ .74	- .49	- .18	+3.79	-1.66
Jacksonville, Fla	+6.04	- .15	- .59	- .16	- .69	- .76	- .69	+ .95	+1.01	+3.02	- .86	+4.38	- .48
Gulf States:													
Atlanta, Ga	- .47	+ .28	+1.90	+ .38	- .72	- .75	- .52	- .37	+4.28	+1.31	- .41	+ .15	- .79
Mobile, Ala	- .03	- .42	+1.71	+2.53	- .46	- .90	- .68	- .92	+ .20	+ .15	- .54	-1.37	-1.42
Montgomery, Ala	-2.92	+ .66	- .64	+2.61	-1.05	- .97	- .46	- .80	+1.41	+1.50	- .43	- .77	-1.12
Vicksburg, Miss	+ .64	-1.31	- .83	+ .66	-1.30	-1.20	-1.14	- .92	+4.64	+3.21	+1.18	- .99	- .98
New Orleans, La	- .90	-1.25	+ .68	+4.73	-1.19	-1.12	-1.05	-1.04	- .82	- .22	+ .36	-1.58	-1.66
Shreveport, La	-5.51	-1.16	- .25	+1.10	-1.16	- .64	- .68	+ .18	+ .33	+ .41	- .79	- .91	- .86
Fort Smith, Ark	-3.66	- .48	+ .31	- .33	-1.08	-1.01	- .96	+ .88	-1.05	- .69	- .19	-1.02	- .40
Little Rock, Ark	-6.95	- .81	+1.39	+ .89	-1.11	-1.25	- .56	- .20	-1.01	- .92	+ .09	-1.02	- .94
Palestine, Tex	-3.01	- .96	+ .17	+2.61	-1.17	-1.26	- .99	- .66	- .52	+ .58	- .43	-1.02	- .90
Galveston, Tex	-4.10	- .58	+2.13	- .68	- .70	- .71	- .75	- .84	- .57	- .92	- .56	-1.28	-1.12
San Antonio, Tex	-4.14	- .63	- .12	- .69	- .75	- .77	+ .21	- .39	+ .47	- .11	+ .18	- .63	- .58
Ohio Valley and Tennessee:													
Memphis, Tenn	-7.74	-1.02	- .99	- .36	-1.18	-1.18	- .45	- .79	- .11	- .66	+ .17	- .63	-1.09
Nashville, Tenn	-7.00	+ .96	+ .16	+ .36	- .97	- .96	- .61	+1.90	- .08	- .27	- .72	- .83	-1.05
Chattanooga, Tenn	-1.73	+ .35	+ .09	+1.68	- .97	- .96	- .78	+2.58	+1.02	- .16	- .17	- .89	-1.07
Louisville, Ky	-6.81	- .43	- .73	+ .24	- .76	- .91	- .22	- .25	+ .28	- .70	+ .61	- .41	+ .77
Indianapolis, Ind	-2.95	+ .19	- .72	+1.01	- .77	- .28	- .32	- .81	- .65	- .24	- .38	- .75	+1.33
Cincinnati, Ohio	-6.32	- .36	- .35	+ .38	- .73	- .77	- .47	- .74	+ .37	- .66	- .50	- .02	- .96
Columbus, Ohio	-5.92	- .34	- .47	+ .78	- .72	- .85	.00	- .73	+1.41	- .29	- .24	+ .06	+2.52
Pittsburg, Pa	-2.21	+1.87	+ .24	+3.45	- .41	- .11	+1.10	- .30	+1.54	+ .08	+ .02	- .31	+1.40
Lake region:													
Oswego, N. Y	- .26	+1.52	- .21	+1.48	- .02	- .26	+ .43	- .43	+ .49	+ .91	+ .49	- .80	+1.46
Buffalo, N. Y	+1.14	+ .33	- .48	+1.47	- .53	+ .28	- .55	- .63	+ .28	+ .44	- .64	- .84	- .45

Cleveland, Ohio	−2.84	−.09	−.35	+.67	−.22	−.66	−.06	−.50	−.24	+.61	−.89	+.12	+1.16
Detroit, Mich	−1.67	−.14	−.49	+.97	−.35	−.70	−.46	−.51	+.72	−.04	−.90	−.68	+.01
Grand Haven, Mich	+.33	−.40	−.56	−.21	−.54	−.68	−.02	−.44	−.27	−.83	−.85	−.42	−.43
Milwaukee, Wis	+.29	−.38	−.64	−.49	−.70	−.56	−.65	−.77	+.51	−.88	−.91	−.27	−.92
Chicago, Ill	−.37	−.61	−.66	−.54	−.73	−.62	+.47	−.80	−.28	−.79	+.12	+.12	−.80
Duluth, Minn	−.88	−.42	−.56	−.16	−.58	+.02	−.71	−.58	−.28	−1.01	−.35	+.85	+1.27
Upper Mississippi Valley:													
St. Paul, Minn	−.09	+.19	−.55	−.19	−.63	−.66	+.07	−.77	+.01	−.90	−.63	+2.54	+.28
La Crosse, Wis	−.59	−.01	−.49	+.17	−.61	−.42	+.05	−.58	+1.90	−.87	+.54	+.41	−1.08
Davenport, Iowa	−.22	−.03	−.60	−.36	−.72	−.63	−.59	−.99	−.25	−1.06	+.11	−.38	−.58
Des Moines, Iowa	+.99	+.93	−.38	−.09	−.80	−.40	−.75	−.18	−.81	−1.21	+.06	−1.37	−.22
Springfield, Ill	−2.18	−.16	−.79	−.32	−.97	+.09	−.94	−1.04	−.74	−.93	+.01	−.86	−.28
Cairo, Ill	−4.37	−.30	−.51	+.77	−.89	−.66	−.49	+.32	−.81	−.73	−.19	−.99	−1.05
St. Louis, Mo	−2.65	−.15	−.35	+.21	−.89	−.98	−.37	−.11	−.03	−1.05	+2.30	−1.26	−1.18
Missouri Valley:													
Springfield, Mo	−1.86	−.13	−.19	+.38	−.82	−1.29	−1.42	+1.88	−1.16	−1.28	−.22	+1.15	−.83
Kansas City, Mo	+.70	+2.16	+.77	−.68	−.78	−.50	−1.02	−.81	−1.03	−1.15	−.74	−1.19	+.77
Concordia, Kans	−.23	+.14	+2.39	−.49	−.59	−.07	−.88	+.58	−.48	−1.12	−.45	−.74	−.82
Omaha, Nebr	−.02	−.33	−.52	−.35	−.84	+.80	−.82	−.92	−.78	−1.15	+1.57	−1.22	+.85
Valentine, Nebr	+.02	−.56	+.49	−.44	−.69	−.64	−.62	−.09	−.28	−.38	−.09	+3.26	+1.88
Huron, S. Dak	−.83	−.38	−.57	−.56	−.40	+.35	−.53	−.51	−.20	−.57	+.76	+3.27	−.45
Extreme Northwest:													
Moorhead, Minn	+.94	+.51	−.46	−.34	+.44	−.50	−.44	−.10	−.44	−.65	+1.63	+.88	−.49
Bismarck, N. Dak	−1.11	−.45	−.40	−.56	−.37	−.53	−.56	−.56	−.56	−.64	+.55	+1.20	+.07
Williston, N. Dak	−.36	−.13	+.10	−.36	−.36	−.42	−.16	−.42	−.33	−.30	+.76	+2.76	+.38
Rocky Mountain slope:													
Havre, Mont	−.86	−.21	+.03	−.21	+1.16	+.60	+.01	−.15	+.96	+.27	−.51	+.96	−.30
Helena, Mont	−.67	−.16	+.15	−.27	+.81	+.79	−.23	+.32	+.70	+.78	−.44	−.24	−.20
Spokane, Wash	+.30	+.75	−.27	−.35	−.34	−.21	−.22	+.03	−.34	+.07	−.24	+.08	−.37
Salt Lake City, Utah	+.60	+.07	−.52	−.48	−.49	+3.65	−.42	−.42	−.20	−.25	−.23	+.81	−.14
Cheyenne, Wyo	+1.26	−.22	+2.03	+.26	−.39	−.44	−.35	−.41	+.58	+.63	−.30	+1.34	−.11
North Platte, Nebr	+.38	−.35	+1.37	−.10	−.48	−.24	−.52	−.60	+.81	−.73	−.35	+2.42	−.81
Denver, Colo	−1.10	−.31	+1.28	−.32	−.59	−.36	−.68	−.56	−.04	−.05	−.24	+1.49	−.31
Dodge, Kans	−.30	+.10	+2.36	−.39	−.13	−.47	−.67	+.91	−.80	−.84	+1.16	−.72	−.12
Oklahoma, Okla	−4.52	.57	+.40	−.51	−.78	−.90	−.99	+1.61	−1.26	−.70	+.17	−.70	.00
Abilene, Tex	−1.26	−.49	−.46	+.06	−.76	−.73	−.41	+2.28	+.32	+1.67	−.82	−.77	−.75
Santa Fe, N. Mex	+1.59	−.12	+.24	+.18	−.10	−.08	+.15	+.40	−.10	+.03	−.21	−.13	−.09
El Paso, Tex	+.11	−.01	.00	+.45	−.07	−.07	−.07	−.14	−.14	−.06	−.07	−.07	+.10
Phoenix, Ariz	+.07	−.07	−.07	−.07	−.07	−.07	−.07	−.01	.00	+.08	.00	.00	−.01
Pacific coast:													
Seattle, Wash	−.46	+1.52	−.62	−.11	+.82	−.57	−.39	+.62	−.43	−.01	−.29	−.21	−.18
Portland, Oreg	+.42	+1.50	−.76	−.31	+.20	−.32	+.28	+.37	−.02	−.19	−.01	−.13	−.31
Roseburg, Oreg	+1.27	+.46	−.63	−.55	−.27	+.41	−.44	+.36	−.14	−.38	−.30	−.27	+.02
Red Bluff, Cal	+1.63	−.07	−.53	−.48	+.63	+.11	−.35	−.24	+.12	−.21	−.14	−.13	−.07
Sacramento, Cal	−.50	−.26	−.56	−.55	+1.29	−.16	−.26	−.21	−.32	+.03	−.07	−.07	.00
San Francisco, Cal	+.02	−.41	−.50	−.45	+.42	+.48	−.22	−.16	+.57	−.07	−.07	−.07	−.07
Los Angeles, Cal	−1.93	−.38	−.33	−.27	−.21	+1.26	−.13	−.07	+.63	−.07	−.07	.00	.00
San Diego, Cal	+2.07	−.21	−.20	−.15	−.14	+.46	−.11	−.06	+.07	+.02	−.01	−.05	.00

Precipitation departures (inches and hundredths) for the season of 1901 from normal based upon observations for many years, by stations—Cont'd.

Stations.	For weeks ended—													
	July—					August—				September—				
	1.	8.	15.	22.	29.	5.	12.	19.	26.	2.	9.	16.	23.	30.
New England:														
Eastport, Me	−0.59	−0.68	−0.82	−0.61	−0.82	−0.50	+0.07	−0.57	+0.61	−0.75	−0.70	+0.57	+0.30	−0.23
Portland, Me	− .77	+ .13	+ .11	+ .23	− .22	− .02	− .03	− .80	+1.41	− .57	− .69	− .14	+ .16	− .19
Boston, Mass	− .52	− .48	+1.16	− .54	+1.96	− .80	− .35	− .85	+1.19	− .59	− .68	+ .36	+ .10	+ .01
Middle Atlantic States:														
Albany, N. Y	− .61	+ .96	− .66	+ .07	+ .23	− .58	+2.03	− .62	− .05	− .16	− .81	+ .19	+ .01	− .19
New York City	− .81	+2.44	− .40	− .60	− .79	+ .15	+ .92	+ .48	+1.85	− .41	− .90	− .03	− .55	− .20
Philadelphia, Pa	− .71	+1.24	− .17	− .19	+ .23	− .92	+ .08	+3.60	+2.62	− .16	− .62	+1.07	− .15	− .33
Washington, D. C	− .98	+ .71	+1.69	− .73	− .80	− .85	+ .72	+ .19	+ .46	− .39	− .85	− .71	− .67	− .01
Lynchburg, Va	− .13	− .68	+1.42	+ .98	− .01	− .69	+3.51	+1.68	− .08	+ .42	− .55	− .62	+ .15	+ .63
Norfolk, Va	−1.03	−1.05	+ .81	−1.13	−1.10	− .08	+ .55	+1.71	+ .44	+ .72	− .98	−1.06	+3.90	− .28
South Atlantic States:														
Charlotte, N. C	− .43	− .88	+3.13	+ .13	−1.22	− .71	+2.27	+ .30	+1.46	+1.59	− .89	− .46	+4.44	+ .24
Wilmington, N. C	−1.14	−1.39	+3.71	+1.14	−1.74	− .09	− .41	− .25	+ .01	− .16	−1.59	−1.49	+ .77	+1.02
Charleston, S. C	− .80	−1.02	+ .61	− .02	−1.69	−1.29	− .50	− .33	− .43	− .70	−1.58	−1.48	−1.43	−1.30
Augusta, Ga	− .82	− .63	−1.13	+1.06	− .93	− .98	+2.20	− .79	− .95	+2.16	−1.07	− .97	+3.74	− .60
Savannah, Ga	−1.43	− .57	+ .01	− .14	− .79	−1.03	+1.10	−1.15	− .43	− .48	−1.55	−1.47	− .39	− .33
Jacksonville, Fla	−1.37	+ .44	− .02	− .55	−1.47	− .89	− .52	+1.81	− .88	− .76	+ .39	−2.23	− .91	+2.17
Gulf States:														
Atlanta, Ga	+ .37	− .99	−1.05	+2.87	+ .59	− .94	+1.16	+1.89	+3.20	− .48	− .96	− .72	+1.90	− .22
Mobile, Ala	+ .48	+ .01	− .79	+ .67	+3.17	−1.56	+1.42	+4.37	−1.30	− .88	− .97	− .80	.00	− .49
Montgomery, Ala	− .62	− .28	−1.05	− .22	− .74	− .91	+1.01	+1.95	+ .62	− .15	− .73	+ .51	+ .89	+1.45
Vicksburg, Miss	+ .13	− .53	−1.05	+ .37	+ .43	− .82	− .31	+1.07	− .33	− .16	− .87	+2.05	− .21	− .68
New Orleans, La	+ .78	+ .45	− .98	+3.61	+ .18	−1.31	+ .09	− .03	+ .43	− .18	− .99	+ .50	+ .51	− .95
Shreveport, La	− .40	− .81	− .84	− .78	+1.26	+1.64	− .08	− .31	+1.04	+ .80	− .81	+1.97	− .79	− .81
Fort Smith, Ark	− .99	− .63	−1.05	− .83	− .33	+1.15	− .27	− .84	− .84	− .71	− .84	− .54	− .84	− .78
Little Rock, Ark	− .91	− .42	− .91	− .42	− .76	+ .84	− .20	− .97	− .51	− .58	− .82	+4.28	− .33	+ .93
Palestine, Tex	− .28	− .68	− .24	− .56	− .37	+3.02	− .51	− .63	− .54	− .65	− .54	+9.60	− .77	− .77
Galveston, Tex	− .85	− .62	− .68	+ .50	+2.61	− .77	+ .84	−1.27	+2.78	+ .29	− .18	+2.53	− .64	−1.29
San Antonio, Tex	− .13	− .48	+1.12	− .45	+1.64	− .24	− .81	− .82	− .77	− .38	+ .24	− .82	− .75	+2.08
Ohio Valley and Tennessee:														
Memphis, Tenn	− .99	− .85	− .77	− .70	− .73	− .43	− .82	+5.25	− .20	− .73	− .77	+4.13	− .01	− .69
Nashville, Tenn	− .98	− .79	− .99	+ .15	− .91	+ .95	− .56	+4.75	+1.21	− .84	− .99	+1.31	+ .27	− .12
Chattanooga, Tenn	− .93	− .93	− .95	+ .26	− .41	− .58	− .18	+4.54	+1.72	+ .12	− .86	+ .07	+1.38	− .28
Louisville, Ky	− .94	+1.46	− .84	− .83	− .84	− .33	− .84	− .26	+ .32	− .49	− .70	+1.11	− .47	+ .22
Indianapolis, Ind	−1.04	− .98	− .98	− .17	− .92	− .84	− .76	+ .44	+1.24	− .23	− .70	− .07	− .67	− .64
Cincinnati, Ohio	− .39	− .69	− .77	− .61	− .76	+ .40	− .88	− .61	− .28	− .67	− .66	− .03	− .46	− .15
Columbus, Ohio	+ .69	− .29	− .73	− .12	− .67	− .57	− .73	− .45	− .35	+ .32	− .63	+ .08	− .12	+ .33
Pittsburg, Pa	− .35	− .26	−1.15	− .60	− .30	− .05	− .17	+ .56	+1.37	− .48	− .60	+ .35	− .25	+ .09
Lake region:														
Oswego, N. Y	− .77	+1.09	− .27	− .70	.00	− .51	+2.29	− .38	+ .56	+ .08	− .63	+1.28	− .13	− .07
Buffalo, N. Y	− .31	+ .81	− .67	− .47	+ .47	− .66	− .04	− .69	− .08	+ .34	− .77	+ .93	− .44	+ .12

Cleveland, Ohio	−.84	+.87	−.73	−.75	+.80	−.29	−.64	+1.73	+1.93	+5.63	−.81	+.20	−.63	+.21
Detroit, Mich	.00	+1.09	−.58	−.53	+2.20	−.47	−.63	−.59	+1.96	+.04	−.61	+.87	−.54	−.41
Grand Haven, Mich	+.24	+1.10	−.56	−.59	+1.48	−.48	−.44	−.42	−.56	−.71	−.72	+1.19	−.01	−.81
Milwaukee, Wis	−.57	+.01	−.70	−.25	+.18	−.63	−.60	−.14	+.25	−.49	−.16	+.54	−.63	−.57
Chicago, Ill	−.58	+1.43	−.77	−.51	+.19	−.70	−.69	+.72	−.09	−.61	−.70	+2.24	−.62	−.63
Duluth, Minn	+3.05	+.96	−.80	+.17	+.69	−.77	+.16	−.32	−.35	−.84	−.93	−.42	−.86	+.91
Upper Mississippi Valley:														
St. Paul, Minn	+.95	+.01	−.77	−.44	+.48	−.75	−.19	−.52	+.28	−.46	−.30	+2.05	−.66	+1.09
La Crosse, Wis	+1.22	+.92	−.91	−.26	+3.08	−.79	−.24	−.48	−.53	−.80	+3.85	+1.01	−.96	+1.98
Davenport, Iowa	−.18	−.36	−.84	−.84	+.20	−.82	−.65	−.55	−.77	−.77	−.68	+.97	−.52	−.44
Des Moines, Iowa	−1.02	+.04	−.78	−.77	+.05	−.62	−.57	−.74	−.51	−.57	−.27	+.61	−.30	−.44
Springfield, Ill	+1.63	−.21	−.61	−.55	−.56	−.43	−.46	+1.77	+.05	−.64	−.72	+.98	−.57	−.73
Cairo, Ill	−1.01	+.36	−.77	−.77	−.73	+3.38	−.59	+1.13	+.58	−.53	−.63	+.97	−.53	−.63
St. Louis, Mo	−.63	+.60	−.84	−.84	−.84	−.77	−.63	−.60	−.43	−.77	−.77	−.15	−.64	−.70
Missouri Valley:														
Springfield, Mo	−.62	−1.07	−1.12	−.83	−.04	−.15	+1.12	−.80	−.49	−.82	−.95	+.17	−.76	−.50
Kansas City, Mo	−.91	−.98	−.95	−.58	+.74	+1.44	−.57	−.89	−.17	−.84	−.84	+.42	−.55	−.40
Concordia, Kans	−.82	+.11	−.70	−.60	−.54	−.03	+.66	−.58	−.63	−.34	+.14	+.54	−.24	−.08
Omaha, Nebr	−1.23	−.21	−1.10	−.25	+.09	−.58	−.29	−.75	−.66	−.70	+.62	+1.46	+.03	+2.01
Valentine, Nebr	+.36	−.64	−.55	−.24	+.21	+.19	−.25	−.19	+.34	+.35	+2.42	+1.09	−.14	−.21
Huron, S. Dak	−.58	−.59	−.69	−.61	−.29	−.38	+1.54	−.53	−.56	−.47	+1.54	+2.44	+.02	+1.29
Extreme Northwest:														
Moorhead, Minn	−.11	+4.03	−.79	−.88	+2.03	−.72	−.06	−.58	+.70	−.44	+.23	−.11	−.49	+1.23
Bismarck, N. Dak	+.02	+1.28	−.32	−.47	+.59	−.40	+.13	−.40	−.01	−.39	−.01	+.24	−.26	+.41
Williston, N. Dak	+1.58	−.15	+.22	−.13	+.84	−.33	+.37	−.27	−.14	−.19	+.19	+.34	+.05	+.43
Rocky Mountain slope:														
Havre, Mont	−.16	−.26	+.51	−.44	−.07	+.03	−.25	−.31	−.28	−.28	+.45	+.17	−.13	+.45
Helena, Mont	+.31	−.36	+.08	−.21	−.13	+.01	−.14	−.13	−.14	−.17	+1.69	−.26	−.20	+.31
Spokane, Wash	−.17	+.20	.00	−.14	−.11	−.02	−.07	−.07	−.07	+.01	+.58	+.19	−.13	+.29
Salt Lake City, Utah	−.11	−.11	+.20	−.08	−.14	−.12	−.05	+.52	+.24	−.19	−.21	−.21	−.21	+.42
Cheyenne, Wyo	−.35	−.36	−.02	−.34	+.44	−.34	−.36	.00	−.05	−.08	+.29	−.04	−.21	−.19
North Platte, Nebr	−.76	−.70	−.63	−.59	−.22	−.54	−.16	−.52	+.02	+.50	+1.34	+.88	+.04	−.28
Denver, Colo	−.35	−.35	−.40	−.42	−.38	+.18	+.17	−.35	−.20	−.15	.00	−.17	−.14	−.19
Dodge City, Kans	−.77	.00	−.70	−.70	+.41	−.70	−.38	−.63	−.61	−.15	+.46	−.23	−.28	+1.36
Oklahoma, Okla	−.63	−.76	−.92	−.99	−.81	−.70	+1.29	−.57	−.21	−.38	−.79	−.03	−.62	−.56
Abilene, Tex	−.63	−.45	−.33	−.28	−.16	−.48	−.59	−.54	+.09	−.60	+1.20	−.56	−.56	−.56
Santa Fe, N. Mex	−.21	−.32	−.23	−.51	+.50	+2.20	−.24	+.10	−.21	−.19	+.76	+.17	−.35	−.31
El Paso, Tex	+.03	+.29	−.48	−.41	−.27	−.42	−.22	−.31	−.35	−.33	−.21	+.40	−.24	−.16
Phoenix, Ariz	−.07	−.11	−.12	−.21	−.02	+.37	+.12	+.22	−.20	+.20	−.07	−.13	−.14	−.18
Pacific coast:														
Seattle, Wash	+.79	−.16	−.14	+.14	−.05	−.13	−.07	−.14	−.07	−.03	.00	−.01	+.28	+.31
Portland, Oreg	+.19	−.09	−.14	−.10	−.07	−.07	−.07	−.12	+.01	−.07	−.20	−.15	+1.15	+.91
Roseburg, Oreg	−.22	−.02	−.10	−.07	−.07	.00	+.41	−.07	+.04	+.66	−.12	−.18	+1.65	+.68
Red Bluff, Cal	−.07	−.02	.00	.00	.00	.00	.00	.00	.00	−.04	−.09	−.14	+1.17	+.31
Sacramento, Cal	.00	.00	.00	.00	.00	.00	.00	.00	.00	−.02	−.07	−.07	+.15	+.21
San Francisco, Cal	−.01	−.01	.00	.00	.00	.00	.00	.00	.00	−.01	.00	−.05	+.55	−.04
Los Angeles, Cal	−.01	−.01	.00	.00	.00	+.09	.00	.00	.00	−.03	.00	.00	−.01	−.06
San Diego, Cal	.00	.00	.00	.00	.00	−.06	−.06	.00	.00	.00	.00	.00	−.01	+.01

PROGRESS IN FORESTRY IN 1901.

[Prepared in the Bureau of Forestry.]

The past year has been the most notable one in the history of forestry in this country. A remarkable increase of interest in the subject is shown by the people, and, as President Roosevelt said in his first message, "public opinion throughout the United States has moved steadily toward a just appreciation of the value of our forests."

The year has witnessed great activity in local, State, and Federal circles. State legislatures have passed laws to encourage forest preservation, several have created departments of forestry, new State forest associations have been organized, and old organizations continue active.

FOREST MANAGEMENT AND INVESTIGATION.

On the 1st of July, 1901, the Division of Forestry of the United States Department of Agriculture was advanced to the grade of a bureau. This was provided for by the last session of Congress, which appropriated for the expenses of the Bureau during its first year $185,440.

The Bureau of Forestry is made up of the Division of Forest Management, the Division of Forest Investigation, and the Division of Records. Each of these continues, with enlarged facilities, work which was in progress under the old Division of Forestry. There were during 1901, in all, 179 persons engaged in the work of the Bureau. Of this number 81 were student assistants—young men, largely college students, who expect to enter forestry as a profession, and who served during the summer on small pay for the sake of the experience gained.

Field work under this appropriation has been going on during the last year from Maine to California and from Georgia to Washington. It includes the study of forest conditions and forest problems all over the country, and the giving of advice to the owners of forest lands, and the supervising of conservative lumbering operations which illustrate forest management on business principles.

When the owner (private or public) of woodland wishes to consider the possibilities of his property if handled as a constant source of timber supply, the tract must be examined by an expert to ascertain the condition of the standing timber, the prospects of reproduction, the facilities for marketing, the best method of harvesting the present crop so as to secure the largest present and future yield, and the likelihood of success under management. A preliminary report is made. If the owner decides on management, a working plan follows. This involves a careful study of the rate of growth of the different kinds of marketable timber, the computation of the proper interval between cuttings and of the amount of timber to be harvested, and, if desired, the recommendation of the necessary regulations to enable the work to go on under contract. All this falls to the Division of Forest Management.

The Division of Forest Investigation makes studies of trees, of their rates of growth, distribution, reproduction, and habits, and investigates the forest problems connected with fires, lumbering, grazing, tree planting, stream flow, and erosion.

The Division of Records includes all office and routine matters, and also has the custody of the library of forest literature and of a unique collection of photographs, which is continually being added to, illustrating forests and forest conditions all over the United States.

FOREST PLANTING.

The past year has been notable both for interest and achievement in tree planting. Never before, not even during the time of wholesale timber-claim planting, were so many trees planted in a single year. Reports of extensive work in this line from Florida, New England, the Middle Atlantic States, the Lake States, and the Pacific States, as well as from all the prairie States of the interior, have been made.

In the West a decided impetus has been given to tree planting by the fact that forest plantations have already proven profitable as financial ventures. On the other hand, in the East planting is found to be a valuable way of reclaiming waste lands and protecting water supplies.

More than one hundred planting plans have been made for applicants by the Bureau of Forestry within the year.

During the summer of 1901 agents from the Bureau of Forestry studied the forest conditions of Nebraska, completing their investigations in October. The investigations covered principally the Platte River and its tributaries, the Pine Ridge district, and the Sand Hill region. In all, over forty counties were traversed.

As a result of this investigation, so thoroughly has the Bureau of Forestry become convinced of the practicability of foresting the sand hills that it is aiding the efforts to secure the setting aside of several tree-planting reserves in that region.

In any event this investigation will be of great value in determining future plans in regard to improving the forest conditions of the plains region.

In no part of the country is wider interest shown in conservative forest management by private owners than in the Southern States. Up to date the amount of private lands in the South for which advice in handling has been asked of the Bureau of Forestry is 1,534,000 acres, and a very large part of the work which will be done by the Bureau for private owners in the immediate future will be in that section.

STATE LEGISLATION FOR FORESTRY.

The Pennsylvania legislature during the year passed an act raising the division of forestry of the State's agricultural department to the position of a department of forestry. The department consists of a commissioner of forestry and four others, who constitute the State forest reservation commission, and are empowered to buy lands for the State forest preserve and to control the same. During the year a number of additions were made to the State forest preserves by purchase, and they now contain about 400,000 acres. The legislature will now be asked to establish a State forest school.

Forest improvement and extension is being taken up in a practical manner by the State of Connecticut. The legislature at its last session passed an act authorizing the appointment of a State forester by the board of control of the Connecticut Agricultural Experiment Station. This act, entitled "An act concerning the reforestation of barren lands," also provides for the purchase of lands suitable for the growth of oak, pine, or chestnut timber, such land to be used as a State park. The annual appropriation for this purpose is small, but the move is one that will greatly increase interest in the forest conditions of the State.

In Indiana a State board of forestry was created by an act of the legislature last spring. In Michigan at the last session of the legislature a tract of about 70,000 acres was set apart for a State forest reserve, and the State forest commission is exerting itself to greatly increase this area. The State university, too, has established a course of instruction in forestry.

The campaign to preserve the redwood forests of the Big Basin, in the Santa Cruz Mountains of California, has met with success. The legislature of that State in March appropriated $260,000 for their purchase. This act not only did a great service to the cause of forestry in the United States, but also gave the State a superb park.

The Minnesota legislature at its session last spring enacted a law that sets aside as a part of the State forest reserves all lands unfit for agricultural purposes that reverted to the State through delinquent taxes prior to 1891.

FORESTRY IN THE PHILIPPINES.

Thorough preparations are being made to establish an effective forest service in the Philippine Islands. The work done during the first fiscal year by the forestry bureau at Manila is most encouraging. The announcement by its director that the working force will be increased and a definite forest policy inaugurated throughout the archipelago at the earliest possible day, makes the outlook for forestry in the Philippines most promising.

According to the report of the Taft Philippine Commission, transmitted to Congress by President McKinley in January, 1901, the public forests of the Philippines cover about 40,000,000 acres—nearly as great an area as the combined national forest reserves in this country. They contain over 385 species of trees, many of which produce valuable gums, rubber, gutta-percha, drugs, or essential oils. Among them are seventeen distinct dyewoods.

The present forestry bureau in the Philippines was organized in April, 1900, under the charge of Capt. George P. Ahern, Ninth U. S. Infantry, and reorganized later in the same year with an authorized force of forty-six assistants. The revenues from forest products at the date of the report amounted to above $8,000 Mexican, monthly.

With practically all the forest lands in the islands under the management of this bureau, the exploitation of timber, judging from results already accomplished, promises to be one of the most interesting economic problems in the Philippines.

A number of trained foresters, recently secured in this country for the Philippine service, have sailed for Manila to enter upon their duties. The Bureau of Forestry of the United States Department of Agriculture has been made an agent for the forestry bureau at Manila in securing men for the service there.

THE SOUTHERN APPALACHIAN RESERVE.

The movement begun in 1899 to establish a forest reserve in the Southern Appalachian Mountains, has received considerable impetus during the year. In January Secretary Wilson's report regarding the preliminary investigation was sent to Congress by President McKinley, who recommended its favorable consideration. A bill appropriating $5,000,000 for the establishment of the reserve was then introduced in Congress, but owing to the shortness of the session and the great amount of important business to be transacted it did not reach final consideration. Meantime the legislatures of Virginia, North Carolina, South Carolina, Georgia, and Tennessee passed bills ceding to the National Government authority to acquire title to lands within their boundaries for forest-reserve purposes. At the present session of Congress the same bill has been introduced in the House and Senate, but the House bill carries an appropriation of $10,000,000. The plan has been received everywhere with approval. As Secretary Wilson says in his annual report, "the creation of the proposed reserve is urgent, in order to protect the headwaters of the important streams, to maintain an already greatly impaired supply of timber, and to provide a national recreation ground which, with the exception of the Adirondacks, will be readily accessible to a larger number of people than any other forest region in the United States."

NATIONAL FOREST RESERVES.

During the year two new national forest reserves were declared by President McKinley—the Wichita Reserve of 57,120 acres in Oklahoma, on July 4, and the Payson Reserve of 86,400 acres in Utah, on August 8; there was also an addition of 142,000 acres to the Cascade Reserve in Oregon.

An interesting matter in connection with the administration of the reserves is the recent action of the Secretary of the Interior in reorganizing the Division of Forestry of that Department. Under the new arrangement this division will be under the direction of a trained forester, and much-needed reforms in the handling of public timber lands may be looked for.

That the administration of all the forest work of the national forest reserves should be united under the control of the Department of Agriculture is generally understood and admitted, and the recommendation of the Secretary of the Interior in his latest report that this transfer be made ought to do much to bring it about. President Roosevelt in his message also directs the attention of Congress to this matter, and it is hoped that this much-needed change may be made at an early day. Secretary Hitchcock sums up the situation correctly when he says that "the presence of properly trained foresters in the Department of Agriculture makes the ultimate transfer of the administration of the forest reserves to that Department essential to the best interests both of the reserves and the people who use them."

More than ever do the people of the West realize the wisdom of the policy of establishing forest reserves and the great need of a careful administration of the timber and water resources of that section.

INSTRUCTION IN FORESTRY.

The rapid increase of interest in forestry throughout the country is nowhere more noticeable than in educational circles, and a most gratifying increase in attendance is reported from the forest schools.

At the New York State College of Forestry there are now enrolled 38 students, an increase of 100 per cent over the attendance of last year. The Yale Forest School has 31 students, and at the Biltmore Forest School the new year has opened with 11 matriculates.

There is a growing tendency on the part of colleges and universities of the country to add courses in forestry to their curricula. Already 47 institutions of learning offer instruction in forestry, and it is worthy of notice that in several cases high schools are following the lead of the universities.

PLANT DISEASES IN THE UNITED STATES IN 1901.

By W. A. Orton, *Assistant Pathologist.*

Taking the country as a whole, plant diseases were less prevalent during 1901 than in the year previous, which was an unusually bad season for several crops.

Outbreaks of fungus diseases are, as a rule, most troublesome during wet seasons. This year, as a result of the prolonged drought in the Central States and the Middle West, this region was unusually free from such troubles. The Eastern and Southern

States received an excessive rainfall during part of the summer, and, as a consequence, suffered severely from several diseases. Other outbreaks in various parts of the country, due to local conditions, were noted. Plant diseases are likely to prevail in epidemics, which cause great loss for one or several seasons, and then become less troublesome. Several such outbreaks are now prevailing and will be mentioned below.

These brief notes on the relative prevalence of plant diseases in the United States were prepared in the Bureau of Plant Industry, with the hearty aid of the officers of the State experiment stations. This general survey shows that even in a favorable year the losses from plant diseases in this country are enormous. The total damage can not be estimated, but it certainly amounts to many millions of dollars. A regrettable feature of this subject is the fact that a large part of this loss could have been avoided by proper attention to the remedies worked out by this Department and by the State experiment stations.

Among these destructive diseases that are now easily preventable are the scab and leaf-spot diseases of apple and pear, peach-leaf curl and peach yellows, black rot, downy mildew, and powdery mildew of the grape, late blight and scab of potato, the various smuts of wheat and oats, and numerous other minor troubles.

On the other hand, there is increasing evidence of the widespread adoption of these preventive measures against certain plant diseases with such profitable results that spraying and seed treatment have come to be regarded as indispensable adjuncts to farm practice. Investigations of all the most troublesome diseases are now in progress, and the farmer should not fail to keep himself informed of the results of this work through the bulletins and reports of the Department and the State experiment stations.

This article gives a brief statement of the prevalence of plant diseases in the United States as compared with previous years, with an account of the year's progress in our knowledge of their treatment, and some instances of the successful application of remedies previously discovered.

APPLES, PEARS, AND QUINCES.

Bitter rot of apples, as usual, has been very destructive from Maryland and Ohio southward, but has not caused such enormous losses as last year, except in northern and eastern Texas, where it is reported to have been serious. Spraying has been partially successful in controlling this disease. Pear blight has been particularly bad on apples in the Allegheny region, and to a lesser extent elsewhere. Black canker has excited alarm in Idaho and Montana, but in Oregon has not been so serious as in past years. The eastern apple-tree canker is becoming increasingly prominent in New York, Ohio, Maryland, and other States. Scab was prevalent, as usual, over a large part of the apple-growing regions and did much damage to unsprayed orchards. It has increased in the West during the past two years, and was worse than usual this year in California.

Crown gall has aroused considerable attention all over the country. It is reported as injurious not only to the apple and pear, but to the peach, apricot, grape, rose, raspberry, and on nursery stock in general. Root rot has given trouble in Oklahoma, Arizona, Arkansas, and Colorado. Rust and leaf spot have been locally epidemic in unsprayed orchards in various States, and powdery mildew has been reported from New Mexico.

Among pears blight continues to prevail over the whole country. It was particularly bad during the past season in Texas and in portions of California and adjacent States that have until recently been free from it. It has done much damage in Colorado and Utah.

Quinces and pears have suffered from leaf spot and scab where spraying has not been practiced.

PEACHES AND OTHER STONE FRUITS.

Brown rot was enormously destructive to the early peach crop of the South, and to all peaches and plums in the East. In Connecticut and elsewhere it ruined the greater part of the crop. In Michigan, Missouri, and Illinois it was not so bad as last year. Spraying has not proved generally successful against this disease, partly because peaches and Japanese plums have proved very susceptible to injury from Bordeaux mixture, and the proper methods of treatment are yet to be worked out.

Peach yellows caused considerable loss in localities where preventive measures were not adopted. It was especially prevalent in the northern part of the Michigan peach belt. Where strict attention is paid to the removal of all diseased trees this malady has not been epidemic. The "little peach" disease has been very injurious in Michigan, and is now known to be quite widespread in western New York.

Peaches in Florida and Georgia have been injured by the root nematode. The losses from leaf curl have been considerable where spraying was not practiced, in northern Ohio sometimes reaching one-third to one-half of the crop of susceptible varieties. Spraying for this disease has become a common practice in many places with very successful results.

Scab, leaf rust, shot-hole fungus, and other minor diseases are occasionally noticed, but do not cause relatively great loss.

Plums suffered more from brown rot than from other troubles. Black knot occurred as usual.

Cherries were greatly injured by brown rot, and in New York the Morello cherries especially were injured more than usual by the shot-hole fungus.

SMALL FRUITS.

Black rot has been the most serious grape disease as usual, but has not been so generally destructive as last year. In Maryland, West Virginia, Ohio, and North Carolina it has been very severe, especially in the latter State, where it nearly ruined the Niagaras, and was very severe on Delawares even where sprayed, partly on account of the very rainy season. The white rot has given trouble in Ohio, but preventive measures there have been entirely successful. Anthracnose has given rise to frequent complaints, but has not been especially severe. Unsprayed grapes suffered in New England from downy mildew and in Idaho and neighboring States from powdery mildew. A root rot disease has done damage in California and another is reported from Alabama.

Strawberries were injured in some localities by leaf blight. This disease was worse on old beds, as usual. The summer drought injured many beds in Arkansas.

Raspberries have been injured by anthracnose in New York, Maryland, Minnesota, and elsewhere, though perhaps not more than usual. Cane blight was destructive in Ohio and New York. Crown-gall was found abundant on this and other fruits.

Blackberries have been injured in Maryland by the orange rust.

Among currants anthracnose has been epidemic in the Hudson valley, where it caused very unusual losses. Cane blight has continued to cause considerable injury in the Hudson Valley and other parts of New York. Leaf spot was common late in the season.

The English varieties of gooseberries have been badly injured by powdery mildew where spraying was not practiced.

Cranberry scald caused the loss of one-fourth of the crop in New Jersey, and was injurious in Massachusetts, Connecticut, New York, and Wisconsin.

SUBTROPICAL FRUITS.

"Die back" has been serious among Florida oranges, especially in new groves, but is being successfully prevented by the use of Bordeaux mixture. The "gum disease" of the orange has occurred as usual in California. Pineapple blight has been injurious in Florida, causing losses estimated at $50,000. The disease known as "spike" has also been troublesome and root-knot due to nematode worms has been found on pineapple.

Tuberculosis of the olive has spread very much in California and now threatens to entirely destroy the industry in a portion of the Sacramento Valley.

FIELD AND TRUCK CROPS.

The potato crop was very much reduced in New England, New York, and Pennsylvania by an unusually serious epidemic of late blight. This came late in the season, but the rotting of the tubers following the blight took a large part of the crop in many cases. This disease is almost entirely preventable by spraying, and many thousand acres in potato-growing sections of Maine and other States were successfully protected in this way. Early blight caused complaint in Maryland, Ohio, Arkansas, and Iowa. Rhizoctonia has been found on potatoes over much of the country, but rarely does much damage. Scab continues to injure potatoes where seed treatment is not practiced, and is now reported oftenest from the Western States. The formalin treatment for scab has continued to replace corrosive sublimate, and the Vermont Station has found that formalin gas is equally effective and easier to use than the solution usually employed.

Among tomatoes the bacterial wilt has been troublesome in the South, especially from Alabama to east Texas. Leaf blight has been more than usually injurious in the east, from Vermont to New Jersey. Experiments made by the Department have

shown that this disease can be easily and economically controlled by spraying with Bordeaux mixture. A wilt disease that has not yet been studied does much harm in California, Arizona, Idaho, and Utah. The tomato crop of Maryland and other Eastern States was greatly reduced on account of the failure of the fruit to set. Cucumbers have suffered from mildew in the Eastern States. Unsprayed fields in New York were entirely ruined. Spraying has been shown to prevent the disease and is now considered to be necessary. Anthracnose has been prevalent in Massachusetts, Ohio, and elsewhere.

Muskmelons or cantaloupes were much injured in the South by leaf spot. In western Maryland almost the whole crop was lost. They were subject to several diseases in the Eastern States, especially downy mildew in the Long Island and Hudson Valley districts of New York and a combination of mildew, leaf spot, and anthracnose in Massachusetts, Connecticut, and New Jersey. Thorough spraying did much toward saving the crop.

Squashes suffered from a disease of unknown nature in Massachusetts and Rhode Island.

Among watermelons the wilt disease has continued to prevail in the South, but great losses are not feared, since the growers have generally adopted the advice of the Department not to grow watermelons twice on the same land. This disease has been reported from eastern Maryland during the past season.

Asparagus rust has been less destructive than heretofore in the Eastern and Southern States, although it continues to do much harm. It is reported to be increasing in severity in Iowa, North Dakota, and other Western States. Experiments made by the New York State station on Long Island have shown that the use of a resin-Bordeaux, applied by a specially constructed spraying apparatus is profitable and successful in controlling this disease.

The Florida lettuce crop has been much injured by the "drop" (*Sclerotinia*). The loss there is estimated at $10,000. Lettuce in greenhouses in New York has suffered more than usual from mildew (*Bremia*), and other diseases have been widespread and injurious. The Massachusetts station has found that the "drop" and *Rhizoctonia* can be controlled by sterilizing the soil in the greenhouse, or by covering the beds with a thin layer of sterilized soil or sand.

In celery, leaf blight has been prevalent in the Eastern States and Florida, and continues to be the greatest hindrance to the successful culture of this crop. Recent experiments at the Maryland station have shown that the disease may be easily controlled by spraying with Bordeaux mixture or ammoniacal copper carbonate.

Cabbage black rot continues to be the most widespread and injurious disease of that crop. It was reported as causing loss in New York, Massachusetts, Maryland, and Ohio, and there was a serious and extensive epidemic of it in the coast region of Texas. The wilt disease nearly ruined the cabbage crop in eastern North Carolina outside of the trucking belt, and was injurious in Maryland.

Sugar beets in New York, Ohio, and Michigan suffered severely from leaf spot. In Utah, Colorado, Nebraska, and to a slight extent in the Middle States the disease known as "curly top" was prevalent and injurious.

Onion smut was locally troublesome in Ohio and Arkansas. The Ohio station has demonstrated that formalin and lime are practicable and efficient remedies for this disease.

The Vermont station has studied carefully a bacterial disease locally injurious to carrots, which also attacks a number of fruits and vegetables.

Damping off in radishes has been common in New York.

The rhubarb leaf spot has been common and injurious in New York.

The bacterial disease of beans is becoming more widely distributed. It is reported this year to be unusually common in Vermont and Michigan.

Cowpeas in the Southern States are attacked by wilt and the nematode root knot. The Department has shown that it is probable that these diseases may be overcome by the selection of resistant varieties.

Cassava in Florida has been affected more this season than ever before by a disease known as "frenching."

Alfalfa in New York was much damaged by rust. In Texas, New Mexico, and Arizona a root rot has been the cause of much loss.

In Iowa clover was more injured by rust than for several years before.

In North Dakota the wilt disease of flax has become more widespread and injurious. The cause of this disease has been found by the North Dakota Station to be a fungus, *Fusarium lini*, which attacks the roots and stems.

The leaf spot of tobacco has been unusually injurious in Virginia during the past two years. A new disease, known as "ring spot," not of fungous or insect origin, has recently come to the attention of the Department. The mosaic disease does

more or less damage every year, especially in the Connecticut region. In the seed beds "damping off," caused by *Thielavia basicola*, has given trouble. The control of the black rot in cased tobacco has been accomplished by the bulk method of fermentation, through the investigations and directions of the Department of Agriculture, with the result of saving many thousands of dollars to the tobacco industry.

CEREALS AND COTTON.

Wheat did not suffer so much from rust and smut as in former years in the country as a whole, but these diseases continue to cause immense losses. The formalin treatment of seed wheat and oats for smut is coming into general use instead of hot water, on account of the greater ease in applying it. In many places, notably in North Dakota, this treatment has come into such general use that the grain smuts do not cause great loss.

Smut in oats is complained of in several States, but as a rule has not been more prevalent than usual.

The wilt disease has been the most serious disease of cotton. It is now widespread from North Carolina to Louisiana in both sea island and upland cotton. Strains of sea island cotton have been secured by selection that are resistant to the disease. Cotton throughout the South suffered from unfavorable weather conditions. In Georgia there were several severe outbreaks of anthracnose, and in Louisiana the anthracnose did very much damage. Black rust was bad on poor lands in Arkansas. In Texas the root rot was widely distributed, irrespective of soil characteristics, and very injurious, the loss reaching in some cases, 25 to 40 per cent. It was not so bad as last year, however.

WALNUTS AND FOREST AND SHADE TREES.

Walnuts in California have continued to suffer from the bacterial blight. The Department has demonstrated that this disease can be partly controlled by spraying, and by selection and breeding of resistant varieties.

Forest tree diseases have been studied by the Department and descriptions of two diseases of the red cedar, white rot and red rot or "peckiness" have been published, with suggestions as to their control. Information has also been acquired on several diseases of pine, spruce, fir, hemlock, and other trees, that are injurious in New England. The New York Cornell Station has published the result of some studies on timber destroying fungi.

Various leaf blights have been injurious to shade trees in different parts of the country. The horse chestnut suffered from *Phyllosticta* in New York. Anthracnose of the hickory aroused complaint in New Jersey, while a similar disease of the oak was troublesome in Massachusetts.

Cottonwood trees in North Dakota were much injured by rust, and maples on Long Island were attacked by the black leaf spot, *Rhytisma*.

GREENHOUSE AND ORNAMENTAL PLANTS.

A number of serious diseases have given trouble to this class of plants. Some of the more important are mentioned here.

Stem rot has been very prevalent in asters and has done much damage throughout the eastern part of the country. It is also reported from Michigan.

Stem rot has been widely distributed among carnations. An unusual amount of injury is reported from New York, Rhode Island, and Maryland.

Leaf spot has been less prevalent with violets than heretofore, largely on account of the general use of hydrocyanic acid gas for fumigating, as recommended by the Department, in place of tobacco, which is likely to injure the plants and favor the leaf spot disease. There has been a very widespread and extremely injurious epidemic of the bud nematode, making violet growing unprofitable in many cases.

Rust has been more prevalent than usual among chrysanthemums in New Jersey and Indiana.

Snapdragons in New York have been attacked by an anthracnose and stem rot, and mignonette has been badly infected with leaf spot.

GRASSES AND FORAGE PLANTS FOR THE YEAR 1901.

By W. J. SPILLMAN, *Agrostologist.*

The most important movement among American farmers relating to grasses and forage plants during the year has been the very general interest aroused among the Eastern farmers concerning the forage value of alfalfa. As is well known, this plant

has been the staple fodder crop of the irrigated sections of the far West for the past quarter of a century. Sporadic efforts have been made to introduce it into the Eastern States, but without success until in the last few years. A number of farmers who have been growing it on a small scale report success with it in New York, Ohio, Illinois, southern Wisconsin, and as far south as Mississippi and Georgia. The experiment stations in the Eastern States have encouraged the movement and have issued considerable literature on the subject. The office of Grass and Forage Plant Investigations has distributed enough seed to sow an acre to each of a number of farmers in five selected States and the interest is such as to warrant the belief that this crop will become an important one all over the country in the very near future.

The limits of the successful cultivation of brome grass (*Bromus inermis*) are becoming better understood. The work of the past year indicates that on the wheat soils of the far Northwest where timothy does not thrive, brome grass is of inestimable value, particularly for permanent pastures in eastern Washington, eastern Oregon, and northern Idaho. This region has heretofore been devoted almost exclusively to wheat growing, but a genuine interest has been aroused in live stock farming; brome grass and a number of other standard grasses are being sown very generally, particularly red clover, alfalfa, meadow fescue, Italian rye grass, and orchard grass.

During the past year interest in Turkestan alfalfa has greatly increased, calls for information concerning it coming to the Department from all parts of the United States and Canada. Unfortunately the seed crop during the last year was a failure, for which reason it has been impossible for the Secretary to supply calls for it or to experiment further upon the limitations of its profitable culture.

Soy bean and cowpea have attracted very general attention during the past year. The area of the cultivation of soy bean has extended eastward and southward from Kansas and Nebraska, where it first obtained prominence as a forage plant in this country. It has proved to be especially valuable in Kentucky where the experiment station pronounces it the best of the new legumes. The cowpea is working its way north and is reported as being successfully grown in northern Illinois. The variety which has thus invaded the corn belt is that known as the "whip-poor-will." In the Southern States the cowpea occupies the same place that red clover does in the Northern States. Its growing popularity in the Northern States is partly due to the fact that in many places it has become very difficult to get a crop of red clover. Farmers have very generally learned the value of leguminous crops for supplying nitrogen to the soil and furnishing proteids to live stock, and the cowpea seems to be one of the few things which can be successfully substituted for red clover.

The hay crop was exceedingly short in the middle West the past season on account of the almost unprecedented drought. Deep-rooted plants, such as alfalfa, and drought-resisting crops such as kafir corn, gained much in popular favor during this drought. Should it result in the general introduction of these crops into regions subject to drought, the long, dry summer will not have been without value to the farmers.

PROGRESS IN FRUIT GROWING IN 1901.

By W. H. Ragan, *Special Agent.*

The introduction into California, by the United States Department of Agriculture, of the blastophaga or fig wasp has fairly passed the experimental stages, as is well proved by the largely increased production of Smyrna figs at Fresno, in that State, where a colony of this useful insect has been established. The yield of cured Smyrna figs at Fresno for 1901 was about 75 tons. Stimulated by these satisfactory results, which may be credited altogether to the good offices of the blastophaga, an organization of Smyrna fig growers has already been effected for the purpose of pushing the industry in all sections of the country otherwise adapted to the production of this delicious fruit. The blastophaga has found such congenial conditions existing in the climate of California that it only appears necessary in planting the Smyrna fig in future to frequently plant among them trees of the caprifig, on which the insects breed and have their natural home.

No fruit has been produced by the trifoliate hybrid orange trees that are being grown in Florida, under the direction of Professor Webber of the Division of Vegetable Physiology and Pathology. These hybrids were produced from seed grown on the grounds of the Department of Agriculture on the hardy citrus trifoliata, the flowers of which were artificially pollenized from varieties of sweet orange. The fruit of the trifoliata, a deciduous and hardy species of the genus Citrus, that will withstand the climate of Washington, and even farther north, is of itself of little or no value as an edible fruit, but it is hoped to obtain fruit from hybrids of it acceptable in quality and sufficiently hardy to bring the latitude of orange culture much

farther northward. The hybrid trees being tested are reported to be healthy and promising, with flower buds developing at this time (March, 1902).

A series of very interesting experiments is being conducted by the Pomological Section of the Bureau of Plant Industry, to determine the exact time and condition of maturity for picking apples and pears, to find how they should be treated afterwards, how long after picking before they should be placed in cold storage, and what degree of temperature will give the best results. These experiments are being conducted with the greatest degree of accuracy as to every detail, and at the present time give promise of most valuable practical results. Time will be required to obtain definite data on which to base final conclusions, though reports of progress may be expected from time to time.

The Department of Agriculture has not relaxed its efforts to introduce and encourage the culture of the date in Arizona and California. Prof. David G. Fairchild, who is abroad, representing the Bureau of Plant Introduction of the Department, has recently sent forward a number of plants of this very useful species from the delta of the Nile that give promise of their successful adaptation in the region referred to. They are to be placed in the hands of careful cultivators for trial.

It is estimated that citrus-fruit consumers paid $18,000,000 for the California product of last year. Of this, $10,000,000 went to the producers and $8,000,000 to transportation companies. This large crop of California citrus fruit thrown upon the eastern markets has greatly decreased the importation of foreign-grown fruit. It would appear that bringing foreign-grown citrus fruits to America is already a risky business.

Under the fruit-inspection act of the Dominion of Canada apples, for exportation, must be packed under the inspection of a "boss packer," who must affix his name, with the grade of fruit, on each barrel or package. This insures the shipment of only such fruit as is represented. A circular of advice in detail was sent to all packers, carefully defining their duties.

Mutual association of kindred interests is greatly forwarding the fruit-producing industries of the Pacific coast sections. Such associations combine to secure better shipping facilities and to cheapen their product to consumers.

Also, several of the leading railroads are aiding and encouraging the fruit-growing industries along their lines by the erection of modern storage warehouses within easy reach of the producers, and by improvement of their transportation facilities. Increased shipments and larger profits to growers have already resulted. In anticipation of further growth of shipments this year one road is building 750 refrigerator cars.

During one week in October, 1901, over 3,000 barrels of pears were exported to Great Britain and many more to France and the Continent of Europe. Prior to the late Paris Exposition almost no American pears went abroad. The exhibition of this fruit then made by American growers has already opened up this great market to our producers.

A good prospective demand for American apples is developed in Austria. Large, yellow, and light-colored apples are best for that market. The foreign demand for American apples has steadily increased during the last twenty years. This is largely, if not almost wholly, due to the better facilities for cold storage in transit.

A trial shipment of Valencia oranges from southern California, via Portland, Oreg., and thence to Siberia, has been successfully made, thus testing the practicability of supplying that far-away market with American-grown fruit.

THE PRINCIPAL INJURIOUS INSECTS IN 1901.

By F. H. Chittenden, *Assistant Entomologist.*

During the calendar year 1901 injuries by insects were considerably less than in many years. Nevertheless, certain species made their appearance in normal numbers, some increased in destructiveness, some pests not previously known as occurring in this country were observed, and much work of value was done in the Division of Entomology of this Department and in the experiment stations. A feature of the year was the increased cooperation of this Department with experiment stations in entomological work and the unusual amount of experimentation that was carried on throughout the country with insecticides and other methods of control of insect pests. Another feature was the almost total absence of many insects which had been destructive in recent years in many localities. Some of these species were restricted, according to reports, to limited areas, and the injury was so slight as to scarcely require comment.

Among the noxious species which were conspicuous by their absence, except in very restricted localities, were the chinch bug, the variegated cutworm, the

destructive green pea louse, the fall army worm, and the beet army worm. Cutworms generally, as well as wireworms and white grubs, were hardly as destructive as in the previous year.

Among the common pests that occur year by year which were present and caused injury in some regions were the plum curculio, some species of flea-beetles, most of the fruit-tree borers, some common species of plant-lice and bark-lice, the codling moth, pine bark-beetles, different species of cabbage worms, and the striped and twelve-spotted cucumber beetles.

INSECTS INJURIOUS TO CEREALS AND FORAGE CROPS.

The most noteworthy damage to cereals, and perhaps most notable of all insect invasions of the year, was that of a grain louse, *Toxoptera graminum* Rond., which created great havoc throughout a large portion of Texas, utterly destroying many fields of wheat and very seriously injuring others. This is the more remarkable in that the insect for a period of several years did comparatively little injury. It was first introduced from Europe, according to available references, some time prior to 1882, and has become established in several States. It attacks other useful plants, including various cereals and grasses. It is not probable that it will occur in the same numbers in the near future.

Several other plant-lice, in addition to the grain louse just mentioned, were destructive to cereals, and one of these (*Aphis mali* Fitch) was stated to have done much damage to young wheat in Ohio.

The Hessian fly, which was so destructive during 1900, was somewhat less injurious the past season. Reports of injuries were received, however, from the States of New York, Ohio, Pennsylvania, Tennessee, Texas, North Carolina, Illinois, Missouri, Oregon, and Michigan.

Doubtless, owing to the same atmospheric conditions that caused the increase of some other insects, such as mosquitoes, corn billbugs of several forms were quite destructive in many parts of the country. A species new to science has been reported as not only injuring, but breeding, in corn, and may prove to be a pest of importance.

INSECTS INJURIOUS TO VEGETABLE CROPS.

Considerable time has been devoted during recent years to the investigation of insects affecting vegetable crops. Principal among these during this year was a European enemy of carrot and celery known as the carrot rust fly, and first reported in New York during the past season. Injury was noted on celery, and one grower complained of the ruin of 6,000 plants on his farm alone. This may develop into a very dangerous drawback to the cultivation of carrots, parsnips, and celery in the United States. The seed-corn maggot was prominent on account of its injuries to beans and peas. Several other bean and pea pests attracted attention, and still other insects contributed their share of damage to vegetable crops. The Northern leaf-footed plant-bug was more in evidence during the past two years than ever before in its history, and what is practically a complete life history has been worked out at this office. It injures vegetable crops, fruit trees, and other plants by destroying the young fruit. The insect enemies of cabbage and other cruciferous crops have been quite destructive, and some new enemies of these crops have been studied. Some species of flea-beetles mentioned in the last Yearbook have continued their depredations, and additional observations in regard to their food habits have been made.

The beet army worm (*Laphygma flavimaculata* Haw.), which was so destructive to sugar beets and some other useful plants in Colorado in previous years, was observed during the year, but no injury of importance was reported.

The destructive pea louse, which occasioned such severe losses to the pea over a large portion of the United States from the Atlantic coast to Wisconsin, in the previous two years, occasioning a loss estimated at about $7,000,000 to this crop alone, was noticed in injurious numbers only in a few isolated localities.

The Colorado potato beetle has continued its spread southward in the Gulf States to many localities where it was hitherto unknown, but it is not probable that it will remain permanently in that region. Blister beetles of several species did customary damage to potatoes and other vegetable crops, and fruit blossoms were also injured.

Instances of extreme injury by the common squash bug were reported, entire crops of young plants being destroyed. Damage was most severe in Pennsylvania, but was noted also in New York, Ohio, Illinois, Iowa, and Georgia.

The harlequin cabbage bug, which did comparatively little damage during 1900, particularly northward, has begun to retrieve its lost territory in the Northern States, and was noticed to have done injury in Virginia and West Virginia, as well as in Georgia, Mississippi, and Missouri. It is well known that humid or rainy

weather is favorable to the development of certain plant lice, and particularly to the melon louse. During 1900 this insect was reported at this Department as doing damage only in one locality, in Nebraska, but during the past year reports of injury were received from seven States. It was also the occasion of injury to cotton.

The variegated cutworm, which was one of the most destructive insects during 1900, was reported from only three States, Washington, Pennsylvania, and Virginia.

INSECTS INJURIOUS TO FRUIT TREES.

Work against the San Jose scale and related insects which affect fruit trees has been continued, as reported on page 104 of this book, and in this work many experiment stations cooperated. The codling moth was carefully studied in the State of Idaho and in cooperation with the State entomologists in neighboring Pacific States. Particular attention was given to the occurrence of this species in the arid regions, and by accurate study of its life history results were obtained which will greatly facilitate the control of the insect in the future.

In Georgia the remedial treatment of the plum curculio was undertaken on an extensive scale, jarring being the principal method of experimentation. A new species of aphis destructive to peach and plum in the same State was studied.

Owing to the fact that an extensive outbreak of the periodical cicada is due during the season of 1902, this insect was given considerable study at several experiment stations. The Division of Entomology also issued a circular of warning.

Different species of plant lice, known as the apple louse, were the occasion of considerable trouble. these insects appearing to be on the increase as apple enemies.

The cherry or Forbes's scale (*Aspidiotus forbesi* Johns.), judging from correspondence, now occurs over a very considerable territory, from New York to Florida, and was doubtfully identified with injury in Illinois. Its attacks, in addition to stone fruits, included the apple. The European orchard scale (*Aspidiotus ostreæformis* Curt.) has extended its range, injury being noticeable from New York and Connecticut to Georgia, and westward to Indiana and Illinois. The peach and plum scale (*Lecanium nigrofasciatum* Perg.) has evidently also widened its range, having been reported from six States, as well as the District of Columbia. The same is true of the new peach scale, *Aulacaspis* (*Diaspis*) *pentagona* Targ.

INSECTS INJURIOUS TO CITRUS FRUITS.

The white fly (*Aleurodes citri* R. & H.), according to Mr. H. A. Gossard, reached its maximum of destructiveness during the year and occasioned much apprehension, both within the bounds of its present distribution and outside of them. Seventy-five per cent of the orange groves in one county were infested. The cottony cushion scale in the same State was completely held in check by the imported Australian ladybird, its natural enemy. The scale was accidentally introduced in Florida from California with the ladybird by persons ignorant of the habits of the latter, which feeds exclusively on the scale mentioned. It was hoped that the ladybird would destroy other scales in Florida.

Other scale insects have continued their destructive work in Florida and in California. Many reports of injury to orange leaves and twigs were received from different portions of Florida, the purple scale (*Mytilaspis citricola* Pack.) being most often concerned in injury; the chaff scale (*Parlatoria pergandei* Comst.), and the long scale (*Mytilaspis gloveri* Pack.) were less numerous. From California no reports of severe injury by scales were received, but this is undoubtedly due to the fact that in that State fumigation by means of hydrocyanic acid gas and other remedial treatment is a necessity, and most growers of citrus fruits are able to identify the principal scales infesting their groves and are acquainted with the proper remedies; hence, also, the lack of correspondence that has been received here in previous years.

On the whole, it would seem that scale insect injury to the citrus industry in both States is decidedly on the decrease.

INSECTS INJURIOUS TO SMALL FRUITS.

Insect injury to small fruits continued as in former years, but as nearly as can be estimated was not nearly so severe as in the previous season. Many complaints, however, were made, showing that some insects work destruction year after year. The strawberry weevil did injury in localities where it had not previously been observed in destructive numbers, notably in Ohio. It is probable that this insect did more or less damage in other States, our correspondents thinking it not worth while to report injury to which they had become accustomed for a series of years. Few other species of importance reported in previous years as destructive came to notice.

False-worms, or "slugs," the larvæ of sawflies, were as abundant as usual, but there was less complaint of injuries by leaf-rollers than in the past two or three years.

INSECTS INJURIOUS TO COTTON.

The Mexican cotton-boll weevil has continued to increase as a cotton pest in Texas, and has engaged the attention of three members of the staff of the Division of Entomology, including its chief, and information has been obtained which promises practical results of importance, provided the plans for experimentation for the year 1902 be carried out. This matter is considered more in detail on pages 369–380 of this Yearbook.

The cotton boll worm, which in past years has been one of the most serious enemies to the cultivation of cotton, has apparently not been particularly conspicuous on account of its numbers. But in Texas, according to Mr. W. D. Hunter, of the Division of Entomology, about 15 per cent of the cotton crop was destroyed by it. Complaints of losses were also received from Alabama, Georgia, and Indiana, and slight injury by it to corn was noted in and about the District of Columbia.

INSECTS INJURIOUS TO SHADE TREES.

The white-marked tussock moth was as troublesome as ever known in its history, and was rather generally active throughout its range in defoliating maple and other shade trees, particularly in large cities. During its season of activity daily correspondence was received with complaints of injury. Judging from correspondence, the fall webworm was of only secondary importance as a tree defoliator to the last-named species. The imported elm leaf-beetle was also quite destructive in the same manner as the two preceding insects, injury, of course, being confined to the elm. This insect is causing great alarm in New England. The European leopard moth, which was introduced into this country some years ago and which has until recently confined itself to the neighborhood of New York City, including parts of New Jersey, has extended its southern range to Ocean Grove, N. J. Now that it has begun to spread it is probable that its appearance may soon be looked for at places distant from the point of its original introduction. The bagworm has also been as destructive as in former years. The forest tent caterpillar (*Clisiocampa disstria* Hbn.) showed a marked falling off in numbers, and was not nearly so troublesome as in two or three seasons preceding. The oak carpenter moth (*Prionoxystus robiniæ* Peck) did serious damage to sugar maple, oak, and other trees in New York and other States. The imported willow curculio (*Cryptorhynchus lapathi* Linn.) was unusually destructive both to willow and poplar in New York, Ohio, and Massachusetts. It is rapidly increasing its range. The bronze birch borer (*Agrilus anxius* Gory), a native species only recently reported as troublesome, was reported as doing damage in new localities, widely distributed, and it is probable that it may in time prove a great hindrance to the growth of birch, willow, and poplar in parks of large cities in the district which it inhabits, now ascertained as extending from the neighborhood of Boston, Mass., to Rockford, Ill.

INSECTS INJURIOUS TO FOREST TREES.

Investigations begun two or three years ago by Dr. A. D. Hopkins, under the supervision of this Department, were continued, and the results have been published. Particular attention was given to the insect enemies of the pine in the Black Hills Forest Reserve. The subject of the extensive losses that have been occasioned by insects in recent years to forest interests over a large portion of the United States, and more particularly in the north and northwestern regions, have attracted such attention that they have necessitated studies looking toward preventive and remedial measures of value. This work deals with the causes of the death of forest trees, the primary and the secondary enemies, defoliators, natural enemies of the destructive species, how trees are attacked and how killed, the relation of wood-boring insects and wood-destroying fungi to the deterioration of timber, and suggestions for preventing losses. It presents evidence of unnecessary cutting of living timber, and calls attention to the need of further investigation along lines planned for the coming year.

Certain forest insects have also been studied in New York State. In Massachusetts the gypsy moth, in spite of the most strenuous measures employed for its suppression, has extended its range and now a colony is reported to be present in Rhode Island, at Providence. The brown-tailed moth has also increased its range. These two insects are recent European introductions, and were originally observed in the neighborhood of Boston, Mass., from which region they have spread to neighboring towns. The former is nearly omnivorous, but naturally feeds on forest trees; the latter is rather partial to fruit trees.

INSECTS INJURIOUS TO THE GRAPEVINE.

The grapevine Phylloxera was an object of study at the California Agricultural Experiment Station. This is the worst enemy of the vine, both in America and Europe, and was reported in 1884 as the cause of the destruction of 2,500,000 acres of vineyard land in the United States. Certain other vine pests were abundant, and of those most generally destructive was the grape leaf-folder (*Desmia funeralis* Hbn.). Injuries were reported in the District of Columbia, Maryland, Virginia, Ohio, and Kentucky. The grape curculio, a periodical enemy of the vine, was destructive in Virginia and West Virginia, and was given considerable study in the latter State. The grape berry moth was also troublesome in Virginia and some other States.

INSECTS INJURIOUS TO STORED PRODUCTS.

There was no noticeable diminution in injuries to stored grains. The Angoumois grain moth was the subject of frequent complaint; in fact, this species seemed to be more injurious during 1900 and 1901 than in previous years. Severe injury to grain by this insect was reported from New York, Pennsylvania, New Jersey, Kentucky, Delaware, Maryland, and California. Whether the moist summer weather was a factor in the increase of this insect can scarcely be told. The cigarette beetle was more injurious than in any preceding years. Correspondence in regard to its ravages and the methods to be used in combating it were received from the States of New York, Maryland, Ohio, and Michigan, District of Columbia, and from Porto Rico. Complaint of injuries by the Mediterranean flour moth were made in new localities in California, Wisconsin, and Minnesota. An exotic cabinet beetle, *Dermestes cadaverinus* Fab., recorded in this country years ago, doubtfully in the writer's opinion, made its appearance in great numbers in silkworm cocoons from China, and did much injury in silk mills in New Jersey. It also caused damage to domestic tanned leather, the presence of the insects in a warehouse in New York City being directly traceable to the introduction of quantities of foreign hides. It seems improbable that it has obtained a foothold in this country, and it is hoped that it will be exterminated in the localities where it occurs.

INSECTS INJURIOUS TO ORNAMENTAL, INCLUDING GREENHOUSE, PLANTS.

Complaints of injury to ornamental plants, including those which are grown under glass, were somewhat less frequent than in previous years; but work was continued on some of the more important ones, both in the Division of Entomology and by experiment station entomologists. Some interesting observations on the habits of the fickle midge (*Sciara inconstans* Fitch) were made, which have a bearing on its economic status, and the remedies and preventives to be applied in the treatment of it. Numerous rose insects were observed during the season, and many reports of injury to this plant were received. Some of these rose-infesting species have not hitherto been observed, and a number of them have not been given due attention.

A new enemy of violets was observed. The brown aphis of violets made its appearance in a new locality on Long Island.

Thrips of several species have been unusually injurious in greenhouses, and from reports were more troublesome than in previous years. Frequent complaints were made of their injuries to flowering plants, and requests were made for methods of controlling them.

The common greenhouse red spider was quite troublesome, injuries being reported from Massachusetts, Indiana, Illinois, District of Columbia, and Florida.

PROGRESS WITH INSECTICIDES.

Perhaps more work with insecticides was done than in any previous year. Hydrocyanic acid gas, bisulphid of carbon, petroleum and its products, and several other insecticides were very carefully tested, some at this office and several by different experiment stations. Work with carbon bisulphid as an insecticide was done in the Division of Entomology, the results being incorporated in Farmers' Bulletin No. 145. The entire subject of fumigation by means of the gases above mentioned formed the topic of a book entitled Fumigation Methods, and written by Prof. W. G. Johnson, the labor of the preparation of this work extending over several years, including the year 1901.

The Bureau of Chemistry, in cooperation with the Division of Entomology, made tests of various insecticides, including numerous proprietary articles, which are subject to much adulteration, and the results of these analyses and their effectiveness have been published in Farmers' Bulletin No. 146. Some of the experiment stations also reported analyses of insecticides.

PROGRESS IN APICULTURE.

Apiculture, according to Mr. Frank Benton, Apiarian of this Department, has made greater commercial progress in the West and Southwest than elsewhere. Greater attention has also been given to the keeping of bees in cities and towns. Legislation designed to prevent the adulteration of honey and the spread of contagious bee diseases, and the killing of bees through spraying of fruit trees with poisons during blossoming, has received attention. Efforts have been made toward securing fuller statistics than have hitherto been available regarding the honey crop of the country. Serious discussions regarding the importance of selection in the breeding of bees, as well as the principles governing their breeding, have occupied the attention of many of the apiarian societies and journals. Measurements of the length of the tongues of bees of various races and strains, and consideration of the wing power, hardiness, longevity, and energy in gathering, have thrown some light on the points to be observed in making selection of breeding stock. The uncertain results brought about through uncontrolled mating have served to show more plainly how important it is to devise, if possible, some simple method whereby mating with selected drones may be secured. Additional importations of superior breeding queens have been made from Carniola, Italy, and Cyprus.

MISCELLANEOUS WORK OF THE SEASON.

Mention of the establishment of the fig-fertilizing insect (*Blastophaga grossorum*) in California has been made in this book, as also attempts to introduce foreign insect enemies of introduced pernicious species, such as the San Jose scale, black scale, plant lice, and asparagus beetles.

The work that has been done experimentally with the fungous disease of grasshoppers is, as previously related, not complete, and it is at present impossible to predict the ultimate outcome. The frequent rains during the warm summer months, particularly in the Atlantic region, caused unusual numbers of mosquitoes to appear, and work looking toward the reclamation of marsh land and other breeding places of these pernicious insects has been carried on and will be continued the coming year.

The subject of atmospheric conditions, environment, natural enemies, and other elements which contribute toward the increase or decrease of noxious insects has been continued by the Division of Entomology, and some contributions were made by a volunteer observer, Miss Mary E. Murtfeldt, in Missouri.

Considerable correspondence was had in regard to injury to palmetto in the Gulf States, and to palm in Central America, injury being attributed to the presence of two of our largest species of weevils (*Rhynchophorus*). It is practically conceded that injury is due more to a disease than to the insects, but some species of insects undoubtedly act as transmitters of the disease by flying from diseased trees to uninfected ones.

LEGISLATION FOR ROAD IMPROVEMENT.

By M. O. Eldridge, *Assistant Director, Road Inquiries.*

The trend of road legislation in many States seems to be toward State aid or State cooperation. A State-aid measure has been adopted in Maine, while in Idaho an appropriation has been made to complete a State road. Constitutional amendments providing for State aid have been proposed by the legislatures of Minnesota, Wisconsin, and California. The State-aid laws of New Jersey, New York, Connecticut, and Massachusetts have been amended and appropriations for State-road work increased.

Highway commissions have been created in the States of North Carolina and Michigan. The North Carolina commission, composed of the State geologist and the secretary of agriculture, is authorized to aid county and township authorities, to make rules for the employment of prisoners on the public roads, to issue bulletins of information, etc. The Michigan commission is authorized to make a thorough investigation of the subject and to report to the next legislature.

PROVISION FOR BOND ISSUES.

Massachusetts, Indiana, Minnesota, Pennsylvania, Tennessee, Wisconsin, and Missouri have provided for the issuance of bonds for road and bridge purposes. The State treasurer of Massachusetts has been authorized to issue $500,000 worth of 4 per cent thirty-year bonds; the county commissioners of Minnesota have been authorized to issue ten-year 4 per cent certificates of indebtedness to pay for roads, and in that State the common councils of cities of over 50,000 population may issue bridge bonds. In Tennessee, Wisconsin, and Missouri, the counties may unite with the cities in building bridges, and may issue bonds for this purpose.

CASH TAX AND CONTRACT LABOR.

The contract-labor and cash-tax system of building and maintaining county roads seems to be meeting with general favor and is gradually replacing the old statute-labor system. In Nebraska and Oklahoma road taxes are now made payable in cash in counties under township organization, and the county commissioners are authorized to let contracts for roads and bridges. The legislatures of Oregon and [illegible] pl [illegible] vote of the people and receive a majority of the votes cast before the same shall become operative. The legislature of Minnesota has provided that the highway tax must be paid in cash in all counties having a population of over 150,000.

PROTECTION OF ROADS.

Laws have been enacted relating to the width of wagon tires in Connecticut, Indiana, Minnesota, Pennsylvania, and Rhode Island. The wide-tire law passed in California in 1899 does not become effective until 1903. The laws of Pennsylvania and Indiana fix the weight of load that may be hauled over the roads, the width of tires, and the penalties for violations; the Minnesota law encourages the use of wide-tire wagons by releasing owners from part of their road tax; the Rhode Island measure fixes the width of tires in proportion to the size of the axle, but this law does not apply to wooden axles. In Florida it has been made a misdemeanor to injure roads by hauling heavy loads over them and not repair the roads within thirty days. In Vermont practically the same measure has been adopted, with the additional provision that the road commissioners may repair damages to roads and collect cost from persons injuring the same. In New York the road overseers are required to inspect roads and bridges, to remove stones from highways, and to make annual reports, while the highway commissioners of towns with improved roads are to care for the same under the direction of the state engineer.

SHADE TREES.

The legislatures of Connecticut, Florida, Nebraska, New Hampshire, Pennsylvania, and Washington have all enacted measures relating to the planting and protection of shade trees along the public highways. In Connecticut and New Hampshire the towns may elect tree wardens, and appropriations of 50 cents per poll may be made for shade trees. Penalties for injuring trees are also provided. In Florida the county commissioners are to have trees planted along the public road whenever they shall be petitioned to do so by the freeholders. Penalties for injuring trees, shrubs, bushes, or vines along public roads are provided for in Nebraska and Washington. In Pennsylvania $1 may be paid for each two trees planted by the roadside, and 25 per cent of the road tax may be allowed for that purpose. And in the State of Washington the city councils may raise money for planting and cultivating shade trees by the roadside.

OPENING, LOCATING, AND VACATING.

Measures have been adopted relating to the opening, locating, and vacating of public highways and for protecting the rights of property owners in the States of Georgia, Illinois, Kansas, Michigan, Nebraska, New York, Pennsylvania, Vermont, Washington, and Wisconsin.

PUBLIC CONTROL OF IRRIGATION.

By Elwood Mead, *Irrigation Expert.*

A list of the principal State and Territorial officers charged with supervision and control of irrigation in the arid regions is furnished on page 622. In but three States, Colorado, Nebraska, and Wyoming, is the system of supervision and control at all complete. In several of the States no public control or supervision whatever is exercised, while in others, although the laws have provided schemes of varying efficiency, no officers have been appointed to carry them out. In States where county officers are placed by law in charge of irrigation, difficulty has been encountered in ascertaining if the law has been carried out and officers appointed, but it is believed that the list given is substantially complete.

ARIZONA.

In this Territory the public acequias or irrigating canals are placed by law under the supervision of overseers to be elected and paid by the people whose lands the

acequias water. It is the duty of these overseers to superintend the construction and maintenance of the acequias, and to apportion the water carried by them among those entitled to it. So far as could be ascertained no such overseers hold office at the present time. One water commissioner, whose name is included in the list on page 622, has been appointed by the court at Phœnix to enforce its decrees. This commissioner is an entirely different officer from the overseers provided for as mentioned above. The law of Arizona charges no Territorial officer with duties pertaining to irrigation or irrigation water.

CALIFORNIA.

No public authority is exercised over irrigation in California beyond the fixing of rates for irrigation water by county boards of supervisors and town councils. At one time a number of minor officers were appointed in some of the southern counties, but none are known to hold office now. The office of State engineer, whose duty it was to investigate and report on matters pertaining to irrigation, has been abolished.

COLORADO.

For the administration and control of irrigation water, this State is divided into water divisions which are again divided into water districts. Over each water district is a water commissioner, and over each division is a water superintendent. It is the duty of these commissioners and superintendents to apportion the water of streams according to the decrees of the courts which hold jurisdiction over water titles. It is the duty of the State engineer to measure streams and canals and to otherwise investigate the water resources of the State, as well as to ascertain such physical facts concerning irrigation and irrigation water as may be needed by the courts in decreeing titles to irrigation water or by administrative officers in carrying out such decrees. He also exercises general supervision over the division superintendents and the district commissioners. County commissioners have power to fix rates to be charged for the use of water supplied by canal companies.

IDAHO.

The laws of Idaho provide for the adjudication of water rights by the district courts. Parties interested may elect a water commissioner to enforce the decree, and in case of their failure to do so the judge of the district court shall, on the petition of ten of the users of water, appoint such commissioner. The boards of county commissioners are by law made water commissioners, with power to fix rates and to make such regulations as may be necessary to secure an equal and fair distribution of water. The State engineer has supervision of operations under the Carey Act and the organization of irrigation districts.

KANSAS.

Exclusive jurisdiction of water rights is given to the district courts, which are required to appoint water bailiffs to enforce their decrees. Ditch owners are required to elect superintendents to distribute the water carried by their ditches. The board of railroad commissioners is charged with fixing water rates.

MONTANA.

Under the law of this State a court which has adjudicated the rights to a stream must, upon the application of the parties holding rights to 25 per cent of the water, appoint a commissioner to enforce the decree. The reclamation of land under the Carey Act was placed in the hands of a commission, of which the president and secretary still hold office. No other supervision is exercised over irrigation in the State.

NEBRASKA.

In Nebraska there is a system of public control of irrigation similar to that in force in Wyoming. The State is divided into two water divisions, and there is a State board of irrigation, composed of the governor, the attorney-general, and the commissioner of public lands and buildings, whose duty it is to pass on all claims to water and to adjudicate all water titles, and also, through the State engineer, who is the secretary of the board, to measure streams and canals and investigate the water resources of the State. The board of control elects an undersecretary for each of the two water divisions, who has supervision and control of the distribution of water in his division. The divisions are separated into water districts, which are in charge of underassistants.

NEVADA.

A law passed by the legislature of Nevada in 1901 created a State board of irrigation, to consist of the governor, the attorney-general, and the surveyor-general. By a law passed in 1899 the board of county commissioners of each county may constitute itself, together with the county surveyor, a board of water commissioners. Parties wishing to appropriate water must apply to this board and receive a permit before constructing any works. But one county, Washoe, has thus far availed itself of the provisions of the act.

NEW MEXICO.

The laws of this Territory contain practically the same provisions concerning the management of public acequias as do the laws of Arizona, mentioned above. There is also in this Territory an irrigation commission, whose duties are not, however, connected directly with the administration and control of streams.

NORTH DAKOTA.

Until recently there was a commissioner of irrigation and forestry in North Dakota, but the office was abolished by the legislature of 1901. Parties appropriating water must post and file notices of their intentions.

OREGON.

There is no public supervision of irrigation in Oregon, and therefore no officers for such supervision.

SOUTH DAKOTA.

The only public supervision exercised over irrigation in South Dakota is exercised by the State engineer of irrigation, who is appointed by the governor of the State. His duties are not of an administrative nature, but have to do chiefly with the location of artesian wells.

TEXAS.

Control of irrigation in Texas is left by law in the hands of the commissioners' courts. These courts have not, so far as could be ascertained, appointed any officers to have charge of irrigation matters.

UTAH.

In this State the supervision and administration of water is by counties. The legislature of 1901 passed a law empowering the county commissioners of each county to appoint at least one commissioner to apportion the water within their county. The law took effect so late in the season that in a majority of counties no appointments have been made, although it is expected that they will be before another season ends. The State engineer gauges the streams of the State and instructs water commissioners as to the division of water.

WASHINGTON.

In this State each county is constituted an irrigation district, and for each district a water commissioner may be appointed by the county commissioners. The duties of the water commissioners are substantially the same as those of such officers in Colorado. In times of scarcity the superior court of any county is charged with the duty, upon application by any interested person, of appointing three commissioners to apportion the water of the streams in which the scarcity exists in accordance with equitable and vested rights.

WYOMING.

By constitutional provision all of the water within the State of Wyoming is the property of the State. The State is divided into four water divisions, which conform to natural drainage lines, over each of which is a water superintendent. The four division superintendents with the State engineer constitute the State board of control, which has supervision of the waters of the State and of their appropriation, distribution, and division. The State engineer is president of the board of control. For the administration of the water supplies within the four divisions, these divisions are separated into water districts presided over by water commissioners, whose duties are subordinate to those of the division superintendents.

PUBLICATIONS OF THE DEPARTMENT OF AGRICULTURE.

The publications of the U. S. Department of Agriculture are mainly of three general classes:

I. Publications issued annually, comprising the Yearbooks, the Annual Reports of the Department, the Annual Reports of the Bureaus of Animal Industry, Weather, and Soils.

II. Other Departmental reports, divisional bulletins, etc. Of these, each Bureau, Division, and Office has its separate series, in which the publications are numbered consecutively as issued. They comprise reports and discussions of a scientific or technical character.

III. Farmers' Bulletins, divisional circulars, reprinted Yearbook articles, and other popular papers.

The publications in Class I are distributed by the Department and by Senators and Representatives in Congress. For instance, of the 500,000 copies of the Yearbook usually issued, the Department is allotted only 30,000, while the remaining 470,000 copies are distributed by Members of Congress. The Department's supply of the publications of this class is therefore limited, and consequently has to be reserved almost exclusively for distribution to its own special correspondents and in return for services rendered.

The publications of Class II are not for distribution by members of Congress, and they are not issued in editions large enough to warrant free general distribution by the Department. The supply is used mainly for distribution to those who cooperate with the Department or render it some service, and to educational and other public institutions. A sample copy of this class of publications can usually be sent on application, but aside from this, the Department generally finds it necessary to refer applicants to the Superintendent of Documents, of whom further mention is made below.

The publications of Class III treat in a practical way of subjects of particular interest to farmers. They are usually issued in large editions, and are for free general distribution by the Department. The Farmers' Bulletins are also for distribution by Senators and Representatives in Congress, to each of whom is furnished annually, according to law, a quota of several thousand copies for distribution among his constituents.

A limited supply of nearly all the publications in Classes I and II is, in compliance with the law, placed in the hands of the Superintendent of Documents for sale at cost of printing. Applications for these should be addressed to the Superintendent of Documents, Union Building, Washington, D. C., and should be accompanied by postal money order payable to him for the amount of the price. No postage stamps nor private checks should be sent. The Superintendent of Documents is not permitted to sell more than one copy of any public document to the same person. The Public Printer may sell to one person any number not to exceed 250 copies if ordered before the publication goes to press.

The Secretary of Agriculture has no voice in designating the public libraries which shall be depositories of public documents. Of the distribution of documents to such depositories, including the publications of this and all other Departments of the Government, the Superintendent of Documents has full charge.

For publications of the Weather Bureau requests and remittances should be directed to the Chief of the Weather Bureau.

The Department has no list of persons to whom all publications are sent. A monthly list is issued on the first day of each month giving the titles of all publications issued during the previous month with all the explanations necessary to enable applicants to order intelligently. This list will be mailed regularly to all who apply for it. The Department also issues and sends out to all who apply for them a complete list of all publications of which the Department has a supply for free distribution, and a similar list of all the Department's publications for sale by the Superintendent of Documents.

FARMERS' BULLETINS.

The following list of Farmers' Bulletins is intended to offer the best practical results of the Department investigations. It is not intended to allow any one of them to become exhausted. Reprints are constantly made, so that all are available at all times except when withdrawn. Numbers omitted were attached to bulletins that were out of date and in most cases have been superseded by others presenting more recent information.

16. Leguminous Plants. Pp. 24.
21. Barnyard Manure. Pp. 32.
22. The Feeding of Farm Animals. Pp. 32.
24. Hog Cholera and Swine Plague. Pp. 16.
25. Peanuts: Culture and Uses. Pp. 24.
27. Flax for Seed and Fiber. Pp. 16.
28. Weeds: And How to Kill Them. Pp. 32.
29. Souring and Other Changes in Milk. Pp. 23.
30. Grape Diseases on the Pacific Coast. Pp. 15.
31. Alfalfa, or Lucern. Pp. 24.
32. Silos and Silage. Pp. 32.
33. Peach Growing for Market. Pp. 24.
34. Meats: Composition and Cooking. Pp. 29.
35. Potato Culture. Pp. 24.
36. Cotton Seed and Its Products. Pp. 16.
37. Kafir Corn: Culture and Uses. Pp. 12.
38. Spraying for Fruit Diseases. Pp. 12.
39. Onion Culture. Pp. 31.
40. Farm Drainage. Pp. 24.
41. Fowls: Care and Feeding. Pp. 24.
42. Facts About Milk. Pp. 29.
43. Sewage Disposal on the Farm. Pp. 20.
44. Commercial Fertilizers. Pp. 24.
45. Insects Injurious to Stored Grain. Pp. 24.
46. Irrigation in Humid Climates. Pp. 27.
47. Insects Affecting the Cotton Plant Pp. 32.
48. The Manuring of Cotton. Pp. 16.
49. Sheep Feeding. Pp. 24.
50. Sorghum as a Forage Crop. Pp. 20.
51. Standard Varieties of Chickens. Pp. 48.
52. The Sugar Beet. Pp. 48.
53. How to Grow Mushrooms. Pp. 20.
54. Some Common Birds. Pp. 40.
55. The Dairy Herd. Pp. 24.
56. Experiment Station Work—I. Pp. 31.
57. Butter Making on the Farm. Pp. 16.
58. The Soy Bean as a Forage Crop. Pp. 24.
59. Bee Keeping. Pp. 32.
60. Methods of Curing Tobacco. Pp. 16.
61. Asparagus Culture. Pp. 40.
62. Marketing Farm Produce. Pp. 28.
63. Care of Milk on the Farm. Pp. 40.
64. Ducks and Geese. Pp. 48.
65. Experiment Station Work—II. Pp. 32.
66. Meadows and Pastures. Pp. 28.
67. Forestry for Farmers. Pp. 48.
68. The Black Rot of the Cabbage. Pp. 22.
69. Experiment Station Work—III. Pp. 32.
70. Insect Enemies of the Grape. Pp. 23.
71. Essentials in Beef Production. Pp. 24.
72. Cattle Ranges of the Southwest. Pp. 32.
73. Experiment Station Work—IV. Pp. 32.
74. Milk as Food. Pp. 39.
75. The Grain Smuts. Pp. 20.
76. Toma Growing. Pp. 30.
77. The Liming of Soils. Pp. 19.
78. Experiment Station Work—V. Pp. 32.
79. Experiment Station Work—VI. Pp. 28.
80. The Peach Twig-borer. Pp. 16.
81. Corn Culture in the South. Pp 24.
82. The Culture of Tobacco. Pp. 24.
83. Tobacco Soils. Pp 23.
84. Experiment Station Work—VII. Pp. 32.
85. Fish as Food. Pp 30
86. Thirty Poisonous Plants. Pp 32.
87. Experiment Station Work—VIII. Pp. 32.
88. Alkali Lands. Pp. 23.
89. Cowpeas. Pp. 16.
91. Potato Diseases and Treatment. Pp. 12.
92. Experiment Station Work—IX. Pp. 30.
93. Sugar as Food. Pp. 27.
94. The Vegetable Garden. Pp. 24.
95. Good Roads for Farmers. Pp. 47.
96. Raising Sheep for Mutton. Pp. 48.
97. Experiment Station Work—X. Pp. 32.
98. Suggestions to Southern Farmers. Pp. 48.
99. Insect Enemies of Shade Trees. Pp. 30.
100. Hog Raising in the South. Pp. 40.
101. Millets. Pp. 28.
102. Southern Forage Plants. Pp. 48.
103. Experiment Station Work—XI. Pp. 32.
104. Notes on Frost. Pp. 24.
105. Experiment Station Work—XII. Pp. 32.
106. Breeds of Dairy Cattle. Pp. 48.
107. Experiment Station Work—XIII. Pp. 32.
108. Saltbushes. Pp. 20.
109. Farmers' Reading Courses. Pp. 20.
110. Rice Culture in the United States. Pp. 28.
111. Farmers' Interest in Good Seed. Pp. 24.
112. Bread and Bread Making. Pp. 39.
113. The Apple and How to Grow It. Pp. 32.
114. Experiment Station Work—XIV. Pp. 28.
115. Hop Culture in California. Pp. 27.
116. Irrigation in Fruit Growing. Pp. 48.
117. Sheep, Hogs, and Horses in the Northwest. Pp. 28.
118. Grape Growing in the South. Pp. 32.
119. Experiment Station Work—XV. Pp. 31.
120. Insects Affecting Tobacco. Pp. 32.
121. Beans, Peas, and other Legumes as Food. Pp. 32.
122. Experiment Station Work—XVI. Pp. 32.
123. Red Clover Seed: Information for Purchasers. Pp. 11.
124. Experiment Station Work—XVII. Pp. 32.
125. Protection of Food Products from Injurious Temperatures. Pp. 26.
126. Practical Suggestions for Farm Buildings. Pp. 48.
127. Important Insecticides. Pp. 42.
128. Eggs and Their Uses as Food. Pp. 32.
129. Sweet Potatoes. Pp. 40.
130. The Mexican Cotton Boll Weevil. Pp. 30.
131. Household Test for Detection of Oleomargarine and Renovated Butter. Pp. 11.
132. Insect Enemies of Growing Wheat. Pp. 40.
133. Experiment Station Work—XVIII. Pp. 32.
134. Tree Planting in Rural School Grounds. Pp. 38.
135. Sorghum Sirup Manufacture. Pp. 40.
136. Earth Roads Pp. 24.
137. The Angora Goat. Pp. 48.
138. Irrigation in Field and Garden. Pp. 40.
139. Emmer. A Grain for the Semiarid Regions. Pp 16.
140. Pineapple Growing. Pp 48.
141 Poultry Raising on the Farm Pp 16.
142. The Nutritive and Economic Value of Food. Pp. 48
143. The Conformation of Beef and Dairy Cattle. Pp. 44
144. Experiment Station Work—XIX Pp 32.
145. Carbon Bisulphid as an Insecticide. Pp. 28.
146. Insecticides and Fungicides Pp 16.

ISLAND TERRITORY OF THE UNITED STATES.

The United States under the treaty following the war with Spain in 1898 acquired possession of the Philippine Islands, Guam, and Porto Rico as territory to be governed and provided for. About the same time the Hawaiian Islands, Tutuila with the islets of Tau, Olesinga, and Ofu, in the Samoan Islands, and Wake Island became parts of this country. In Porto Rico and Hawaii experiment stations have recently been established under the Department of Agriculture, while for the Philippine Islands there has been appointed a chief of the insular bureau of agriculture, who acts under instructions from the War Department. An article on agriculture in these islands may be found at page 503 of this book.

PORTO RICO.

On July 25, 1901, a Territorial government was established in Porto Rico. The form is very nearly that existing in New Mexico and other Territories. There is, however, no representation in the United States Congress. Instead a commissioner of the island government, Mr. Federico Degetau, resides at Washington, and looks after Porto Rican interests here.

Up to the date named duties had been collected between the island and the United States, but upon the establishment of a system of local taxation for the island, free trade with this country was inaugurated under a proclamation from President McKinley. A surplus of about $400,000 accumulated under the tariff system, and this money has been used for internal improvements. The sanitary condition of the island has been greatly improved under American control, and with the settlement of governmental relations industry and trade have revived. Commerce with the United States increased nearly one-third during 1901. There is a prospect that the island is entering upon a period of great material prosperity. Among the improvements noted since the American occupation of the islands are the increase of public schools to nearly double their former number, the extension of road building, and the maintenance of better sanitary conditions.

About 24 per cent of the revenues was voted by the last legislature for the schools, and the purpose is to provide a free school for every district. A building for a normal school to prepare teachers who shall understand the conditions thoroughly and be in sympathy with the work is being constructed at Rio Piedras, near San Juan. It was calculated in the report of Governor Allen that about 21 per cent of the population could read and write, and it has been shown that under the first year of American management this was raised about 8 per cent, making the percentage about 29.

Extensive construction of new roads has been planned. The grade is to be 7 per cent or less, and strong bridges are to be built over the torrential streams, which constitute a feature of the island. The cost is estimated at $10,000 to $25,000 per mile. The insular constabulary has been well organized and is considered quite efficient.

In addition to improvement of conditions for health, anæmia, which has been a very frequent cause of death, has been found to be due to a parasite, and its destructiveness materially decreased.

The population of Porto Rico is 953,243, of whom 589,426 are white. In a territory of 3,600 square miles this gives 265 persons to the square mile. This is considerably denser than the population of Connecticut, which has about one-third more territory.

Agricultural interests receive government consideration through the commissioner of the interior, William H. Elliott. An agricultural experiment station under the Department of Agriculture has been established at Rio Piedras, near San Juan, in charge of Prof. Frank D. Gardner. Tests of various plants and of methods of planting, use of fertilizers, etc., are being made. Also a cooperative experiment with the purpose of improving the methods of growing coffee has been undertaken.

The leading crops are shown in the following table:

Areas cultivated in principal crops in 1899.

Name of crop.	Areas.	Name of crop.	Areas.
	Acres.		*Acres.*
Coffee	197,031	Malangas	12,256
Sugar	72,146	Rice	8,667
Bananas	69,380	Tobacco	5,963
Sweet potatoes	37,109	Cocoanuts	5,447
Corn	18,095	Yams	2,098

More detailed information regarding agriculture in Porto Rico may be found in the following publications of this Department: Agricultural Resources and Possibilities

of Porto Rico, by Prof. S. A. Knapp; Agriculture in Porto Rico, by Gen. Roy Stone; Notes on Forest Conditions of Porto Rico, by Robert T. Hill; and Annual Report on the Porto Rico Agricultural Experiment Station for 1901.

Hawaii.

The government of Hawaii, as the entire group of the Sandwich Islands is now called, is essentially the Territorial government which has been in use under the authority of the United States practically ever since the adoption of the Constitution. The governor and other executive officers are appointed by the President, while a Territorial legislature and a Delegate to the United States Congress are chosen under a system of general suffrage. The new government was established June 14, 1900.

The population of the islands, with an area of 6,455 square miles, is 154,001 according to the last census, of whom about one-third are natives, and much more than half the remainder are Japanese, Chinese, and of a mixture of races difficult to classify. The people have taken part in the government for over fifty years, and under the new régime they have control of the legislative branch of government with "Hawaii for Hawaiians" as their leading demand. An income-tax law was passed by the legislature and sustained by the Territorial supreme court. The rate of tax is 2 per cent, and the amount raised is $500,000. The rate levied on real and personal property can not legally exceed 1 per cent. There is also an inheritance tax. The total estimated expenses of the government amount to $1,500,000 in round numbers.

The production of cane sugar is the principal industry. Other agriculture, including horticulture, has been neglected. Considerable impetus has been given to stock growing by the high prices prevailing. Milk costs 10 to 12 cents a quart, and meat and eggs sell for prices quite beyond anything known in the United States. An experiment station under the Department of Agriculture was established near Honolulu in 1901, in charge of Jared G. Smith, formerly the director of seed and plant introduction in this Department.

A tract of land of about 100 acres has been turned over to Mr. Smith for experimental plantings, substantial buildings for the station work have been erected, and some clearing of trees from the ground has been done. A study of the condition of the coffee industry is being made, and horticultural investigations have been planned. Poultry experiments are also in progress. A station for the study of all matters pertaining to the sugar industry has long been maintained by the Hawaiian Sugar Planters' Association. This continues independent of the Department station. The sugar production is large, and the exports of raw sugar make other exports insignificant by comparison.

Potatoes, sweet potatoes, taro, and rice are cultivated to a considerable extent, but the production does not equal the local demand.

Many of the native woods are very valuable, and forestry investigations have been recommended.

Fuller information regarding Hawaii may be found in the following publications of this Department: Agricultural Possibilities and Capabilities of Hawaii; Annual Report of the Hawaii Agricultural Experiment Station, 1901, both published by this Department; Irrigation in Hawaii, and the Hawaiian Islands.

The Philippine Islands.

A civil government under the President of the United States was inaugurated in the Philippine Islands on July 4, 1901. The total area of the principal islands is nearly 119,600 square miles and the population about 8,000,000, nearly half living in the island of Luzon. A large part of this population is made up of half-civilized tribesmen who have never been fully subjected to any organized government. The United States officials are engaged in bringing all to recognize the central authority. As rapidly as possible they are establishing municipal governments in the larger towns. Schools are being established rapidly.

Reports as to the climate vary. The range of the thermometer is small, 61° to 97° being the extremes, with a yearly mean of 81°. Three seasons are assigned limits about as follows: Dry and temperate, November to February; dry and hot, March to May; wet and temperate, June to October. According to one authority, a large part of the sickness reported is due to preventable diseases, and sickness in the United States Army has been rather less in the Philippines than in camp near San Francisco. But the statements of William H. Taft, governor of the Philippines, to Congress indicate that residents of temperate climates who go there to live should be in robust health and should take unusual care to maintain a high vitality.

Agriculture is the chief occupation of the Filipinos. The soil is fertile, and it has

been estimated that a population nearly six times the present could be supported. Agricultural investigations have been placed under the direction of Prof. F. Lamson-Scribner, formerly Agrostologist of the Department of Agriculture. He will be stationed at or near Manila and will direct inquiries and experiments with the purpose of developing agricultural production and improving methods of cultivation and farm management. Much work in forestry has been planned, and a bureau of forestry is already actively engaged in investigations.

Leading products are rice, sugar, hemp, tobacco, and tropical fruits, including cocoanuts and cacao. The production of rice has not been sufficient to supply the home demand, the deficiency being made up by heavy importations. The crops of the other commodities named are largely in excess of the local demand and the exports bring in about $25,000,000 annually. The cocoanuts are sent abroad, mainly dried, under the name copra. This is used for the manufacture of oil.

Guam and Other Islands.

The island of Guam has an area of about 150 square miles, nearly one-half of which is supposed to be susceptible of cultivation. The population is 9,000, nearly all of whom live in the towns. The natives are of mixed descent, including among their ancestors Spaniards, Chinese, and Japanese. They are known as Chamoroos.

The arable land is very fertile, producing cocoanuts, oranges, lemons, cacao, rice, corn, tobacco, sugar cane, and ordinary garden vegetables. Animal life is abundant. Cows and hogs are easily raised, deer and wild goats are numerous, and an animal known as "the flying fox" adds considerably to the meat supply. The only export of consequence is copra, the dried meat of the cocoanut.

Rains occur nearly every day and the temperature is cooler than that of the Philippines.

The principal value of this island to the United States is as a naval station, affording a stopping place for ships on the way to Manila and the Asiatic seas. The government is wholly in the hands of the naval commandant. The old Spanish system of taxation and the municipal governments have been continued, but reforms in marriage customs, the use of liquor, and celebrations have been instituted. A system of unsectarian public schools has been provided.

The other islands of the Pacific, viz, Tutuila, Manua, and accompanying islets in the Samoan group, Wake Island, and several smaller isolated stations are under control of the President through the Navy Department in the same manner as Guam. The islands usually yield tropical products abundantly, but have practically no exports nor imports. The area of these islands amounts to less than 100 square miles, and the total population is supposed to be less than 5,000.

STUDENT ASSISTANTS.

The Department of Agriculture now offers opportunities for study in preparation for certain lines of work to a limited number of persons. The Bureau of Forestry, in which nine-tenths of the appointments of this kind had been made up to the close of the fiscal year 1901, has issued the following statement in regard to this work. The modifications necessary to make the conditions apply to other branches of this Department are not considerable.

"The only position in this Bureau open to those whose training in forestry is incomplete or has not yet begun is that of student assistant. It has been created in order to afford young men who are thinking seriously of making forestry their profession, or who have already taken up its study, an opportunity to become familiar with the methods of this Bureau in the field and in the office. It must be clearly understood that work as a student assistant does not constitute in itself a stepping-stone to higher positions in the Bureau of Forestry, but forms a part only of the training useful in fitting a man for the profession of forestry.

"Student assistants are, as a rule, appointed for the field season only. This varies from three to six months or more, according to the locality and the demands of the work. A limited number are retained after the field season closes, in order to assist in the office of the Bureau in working up data obtained in the field. The eligibility of a student assistant to be continued in the office during the winter depends upon the quality of his field work and upon the seriousness of his intention to take up forestry.

"Student assistants, while in the field, receive $25 per month, with the payment of their expenses for living and for local travel. They are required to defray their traveling expenses to the field from their homes. If they take up work in the office at the close of the field season, the cost of the journey from the field to Washington

is borne by the Bureau. Those student assistants whose services are desired in the office during the winter are assigned to duty as assistant forest experts, and are paid at the rate of $40 per month while working in Washington, but are reduced to $25 per month when again assigned to a field party.

"An application blank for the position of student assistant is furnished on request by the Forester, United States Department of Agriculture. This, when filled in and returned by the applicant, is filed for consideration when the appointment of student assistants for the field season is taken up. The fitness of the applicant for appointment is judged from his answers to the questions upon the blank. The two main conditions upon which his appointment depends are that he has either definitely decided to make forestry his profession, or is at least considering it seriously, and that in age, physical condition, and general training he is well equipped for the duties of student assistant and is fitted to profit by his work. Men, therefore, who have already begun the study of forestry, either at a forest school or elsewhere, and who are in other respects well qualified, stand the best chance of appointment. In the same way, college graduates take precedence of undergraduates, and undergraduates of those who have had school training only."

PUBLIC LANDS OPEN FOR SETTLEMENT.

The figures given in the table below show the location of the public lands in the United States still open for occupation under the homestead and other laws for acquisition of title by individuals. In general, the lands noted in the column "Area surveyed" are available for immediate private occupation under any of the laws now in force for grant of title by the Government. The lands scheduled as "Unsurveyed" must, of course, be surveyed before a grant can be made. The column head "Area appropriated" indicates roughly to what extent the section where the lands are located is already settled and under cultivation.

Applications for and information regarding public lands should be addressed to the registers and receivers of the United States district land offices in the places noted in the table. Full information should be obtained before any move is made toward occupation of these lands.

Lands open for settlement and location of land offices in the United States, June 30, 1901.

[Abridged from Report of Commissioner of General Land Office.]

State and location of office.	Area surveyed.	Area unsurveyed.	Area appropriated.
ALABAMA.	*Acres.*	*Acres.*	*Acres.*
Huntsville	154,630		7,736,970
Montgomery	158,000		24,555,500
ARIZONA.			
Prescott	5,514,406	19,017,541	3,496,897
Tucson	6,100,842	18,138,265	2,239,361
ARKANSAS.			
Camden	784,374		7,728,566
Dardanelle	1,043,407		3,126,093
Harrison	918,220		4,322,780
Little Rock	478,127		15,139,553
CALIFORNIA.			
Eureka	2,914,657	260,443	2,094,513
Independence	8,796,812	3,608,674	706,851
Los Angeles	8,134,082	2,759,335	5,722,458
Marysville	755,349	170,955	4,054,593
Redding	2,689,400	266,158	4,284,890
Sacramento	946,868	289,538	2,192,368
San Francisco	3,757,793	208,824	10,642,801
Stockton	723,819	58,924	4,711,039
Susanville	4,788,692	254,412	1,506,179
Visalia	545,124	119,149	5,941,550
COLORADO.			
Akron	924,140		2,093,360
Del Norte	2,329,481	605,860	1,046,659
Denver	4,770,526	335,090	5,615,684
Durango	2,993,652	537,029	576,019
Glenwood Springs	6,507,014	1,275,103	898,381
Gunnison	1,765,181	533,521	410,218

Lands open for settlement and location of land offices in United States, June 30, 1901—Cont'd.

State and location of office.	Area surveyed.	Area unsurveyed.	Area appropriated.
COLORADO—continued.	*Acres.*	*Acres.*	*Acres.*
Hugo	1,564,340		837,821
Lamar	3,177,894		1,894,106
Leadville	1,431,765	303,869	661,546
Montrose	3,245,831	799,343	555,666
Pueblo	5,001,702	6,240	4,994,458
Sterling	1,008,233		1,954,267
FLORIDA.			
Gainesville	1,299,704	160,070	33,593,607
IDAHO.			
Blackfoot	3,133,761	2,982,772	3,888,967
Boise	4,048,486	7,597,090	1,291,005
Coeur d'Alene	590,426	2,812,779	1,053,066
Hailey	3,094,428	12,813,055	1,174,654
Lewiston	812,988	4,580,391	1,663,261
KANSAS.			
Colby	59,626		6,204,154
Dodge City	721,280		15,435,820
Topeka	1,199		22,257,046
Wakeeney	303,210		6,412,510
LOUISIANA.			
Natchitoches	102,148	65,018	3,848,988
New Orleans	152,169		23,418,603
MICHIGAN.			
Marquette	462,157		36,260,297
MINNESOTA.			
Crookston	500,618	1,093,920	7,237,782
Duluth	1,361,697	1,078,938	5,290,687
St. Cloud	104,970		12,446,910
MISSISSIPPI.			
Jackson	195,980		29,489,140
MISSOURI.			
Boonville	75,920		26,225,080
Ironton	82,220		9,914,770
Springfield	123,577		7,874,263
MONTANA.			
Bozeman	1,799,220	3,966,173	3,288,647
Helena	9,659,369	10,353,126	5,756,045
Kalispell	564,658	4,318,684	1,027,158
Lewistown	3,256,263	2,921,133	1,955,086
Miles City	3,678,058	20,503,633	2,134,849
Missoula	180,878	4,602,112	1,280,977
NEBRASKA.			
Alliance	2,658,957		3,198,241
Brokenbow	2,498,386		1,841,614
Lincoln	6,441		11,852,839
McCook	198,240		5,674,760
North Platte	750,443		3,790,557
O'Neill	666,965		7,968,035
Sidney	584,808		2,681,352
Valentine	2,562,430		2,133,570
NEVADA.			
Carson City	29,667,377	31,651,848	3,031,006
NEW MEXICO.			
Clayton	7,470,104	462,841	914,055
Las Cruces	13,766,806	5,492,658	1,314,861
Roswell	9,425,488	5,862,313	1,230,465
Santa Fe	10,446,110	2,662,804	12,995,114
NORTH DAKOTA.			
Bismarck	6,255,600	3,833,361	6,881,539
Devils Lake	400,200		4,933,520
Fargo	113,920		7,843,150

Lands open for settlement and location of land offices in United States, June 30, 1901—Cont'd.

State and location of office.	Area surveyed.	Area unsurveyed.	Area appropriated.
NORTH DAKOTA—continued.	*Acres.*	*Acres.*	*Acres.*
Grand Forks	40,200	....	4,135,079
Minot	5,163,818	1,119,392	789,810
OKLAHOMA.			
Alva	49,554	....	1,682,446
Enid	960	....	1,161,243
Guthrie	32	....	1,029,538
Kingfisher	409,559	....	2,148,181
Mangum	223,322	....	1,280,412
Oklahoma	74,840	....	2,404,840
Perry	58	....	1,348,227
Woodward	3,895,280	....	1,908,040
OREGON.			
Burns	5,926,529	1,698,016	1,677,455
Lagrande	4,284,995	1,062,985	3,343,660
Lakeview	6,813,218	4,755,589	2,054,148
Oregon City	1,041,345	314,164	4,867,499
Roseburg	1,493,120	1,916,804	6,282,361
The Dalles	4,083,157	394,101	3,767,473
SOUTH DAKOTA.			
Aberdeen	141,740	....	3,172,508
Chamberlain	1,674,630	91,035	1,056,878
Huron	80,876	....	4,294,409
Mitchell	4,569	....	7,164,431
Pierre	1,691,796	....	1,243,177
Rapid City	7,873,025	306,831	2,435,549
Watertown	4,502	....	5,167,498
UTAH.			
Salt Lake City	10,830,242	31,685,613	4,537,917
WASHINGTON.			
North Yakima	630,040	805,379	2,377,498
Olympia	51,431	171,833	2,676,597
Seattle	210,112	791,132	3,491,287
Spokane	789,200	1,969,984	4,614,175
Vancouver	503,424	495,813	3,155,277
Walla Walla	803,788	326,362	2,034,559
Waterville	2,625,948	1,739,218	1,719,755
WISCONSIN.			
Ashland	127,875	....	2,918,792
Eau Claire	53,025	....	14,231,855
Wausau	49,913	....	17,528,067
WYOMING.			
Buffalo	6,542,461	861,657	1,040,829
Cheyenne	9,048,673	81,565	2,953,865
Douglas	7,651,977	226,998	629,025
Evanston	9,754,841	1,868,722	769,559
Lander	4,872,012	1,848,367	499,034
Sundance	4,899,623	....	889,054

TRANSPORTATION ON THE FARM.

An ordinary wagon drawn by two horses will carry at each load a ton to a ton and a half of hay, grain, manure, etc., over a good road; with four horses, 3 to 4 tons. According to distance, the number of loads in a day should be as follows:

Number of loads hauled per day.

Distance.	Number of loads with horses.	Number of loads with oxen.
Eighth mile	16-18	14-16
Quarter mile	12-16	10-14
Half mile	10-14	8-12
Mile to mile and a half	6- 9	5- 7

FREE DELIVERY OF RURAL MAILS.

The appropriation by Congress for the free delivery of rural mails for the fiscal year July 1, 1902, to June 30, 1903, is $7,529,400. The service is no longer treated as experimental, but provision is made for it on precisely the same basis as for the older branches of the post-office work. The establishment of new routes is proceeding as rapidly as possible under existing conditions, and it is estimated that on June 30, 1902, the total population served by free delivery of rural mails will be 5,820,000, while the total number of country residents eligible for the advantages of such delivery is estimated to be 21,000,000.

This service, when fully inaugurated, will very nearly meet the requirements of Article V of the International Postal Convention at Vienna, on July 4, 1891, by which the members of the Postal Union undertook the delivery of mail "at the residences of addressees in the countries of the union where a delivery service is or shall be organized."

The rural free delivery is organized under the First Assistant Postmaster-General, by whom the direct supervision of the work is committed to the general superintendent of the free-delivery system. The principal officials are a superintendent in charge of installation, a superintendent in charge of inspection of the service established and of the investigation of complaints, 7 special agents in charge of divisions, and 60 special agents and 75 route inspectors detailed for active service in the field.

ESTABLISHMENT OF ROUTES.

The delivery of mails by rural carriers is extended in response to petitions presented by the people desiring the service upon forms prepared by the Department, which include a diagram of the proposed route. It is required that the route shall be from 20 to 25 miles in length, so laid out that the carrier will not have to traverse the same road on his return as on his outward trip, and so adjusted that at least 100 domiciles shall be included in the service. Such a petition, when presented to the Department with the approval of the Congressional Representative of the district or of one of the Senators from the State in which the service is asked for, is investigated by one of the special agents in the field, who transmits the papers, with a map of the route or routes to be followed, to the superintendent in Washington for his adjudication.

RURAL CARRIERS, THEIR PAY AND DUTIES.

Applicants for the position of rural carrier are subjected to a very simple examination in respect to their qualifications for the service and the esteem in which they are held by the inhabitants along the routes they are to serve. The limits of age are from 17 to 55 years, except in the case of physically competent veterans of the Civil war or the Spanish war.

The annual pay of the rural carrier is $600, payable monthly, out of which he must provide his own horse and vehicle. The practice of wearing uniform is not obligatory, but is generally followed. Carriers are permitted to carry passengers and unmailable packages for pay, provided this does not interfere with the proper handling of mails. Under certain restrictions also a carrier may act as news agent and carrier for newspapers. The carrier delivers and collects mail all along the route, usually from approved boxes provided by the patrons along the roadside at such height that he can reach them without alighting from his vehicle. As a rule, the carrier leaves the post-office at which his work begins as soon as possible after the arrival and distribution of the principal morning mail and returns in time to dispatch his collection by the evening mail. He cancels all letters collected by him, mailing them in the post-office from which his service originates unless they require delivery en route. He is empowered to register and deliver registered letters and to give receipts for money orders. He carries a supply of stamps for sale and is authorized to affix the requisite postage to unstamped letters and packages, provided the necessary money is deposited in the roadside box with the mail.

Each carrier must furnish a bond for $500 and furnish a substitute similarly bonded, who will perform the duties when the carrier is disabled or absent. The substitute receives the carrier's pay.

The number of routes in operation on May 1, 1902, was 8,438, and the number of petitions for new routes pending on that date was 9,904. The table following shows the figures for the several States.

Rural free-delivery routes and petitions for routes.

States.	March 1, 1901.		May 1, 1902.		States.	March 1, 1901.		May 1, 1902.	
	Routes in operation.	Petitions pending.	Routes in operation.	Petitions pending.		Routes in operation.	Petitions pending.	Routes in operation.	Petitions pending.
Alabama	14	25	48	84	New Hampshire	46	14	93	32
Arizona	2	....	2	3	New Jersey	35	3	71	37
Arkansas	11	8	15	29	New York	219	219	562	343
California	71	5	103	53	North Carolina	11	48	116	302
Colorado	28	20	41	27	North Dakota	5	6	19	15
Connecticut	67	23	131	34	Ohio	302	567	745	893
Delaware	18	12	55	12	Oklahoma	....	....	9	67
Florida	1	1	1	3	Oregon	14	25	28	63
Georgia	59	148	213	453	Pennsylvania	201	81	469	375
Idaho	8	9	12	16	Rhode Island	10	3	15	5
Illinois	337	509	701	927	South Carolina	38	72	145	222
Indiana	314	316	626	502	South Dakota	21	39	52	79
Iowa	292	516	778	796	Tennessee	106	61	269	420
Kansas	187	342	470	580	Texas	35	54	153	355
Kentucky	15	19	37	137	Utah	7	2	12	18
Louisiana	2	4	5	3	Vermont	30	15	78	62
Maine	34	36	114	72	Virginia	16	29	75	219
Maryland	81	61	197	38	Washington	3	19	37	22
Massachusetts	35	30	84	60	West Virginia	35	4	51	54
Michigan	207	415	472	637	Wisconsin	197	214	380	383
Minnesota	120	105	270	424	Wyoming	4	3	5	....
Mississippi	....	1	3	38	Dist. Columbia	....	....	....	2
Missouri	85	225	387	571	Indian Territory	....	....	....	1
Montana	....	5	1	13	New Mexico	....	....	1	2
Nebraska	68	204	207	361					
Nevada	....	....	....	....	Total	3,391	4,517	8,458	9,904

IMPORTANT DATA AS TO FIELD CROPS.

The data presented in the following tables rest upon the opinions of a large number of experts at the State experiment stations throughout the country. Nevertheless, there are inaccuracies, and revision will be necessary. Suggestions and corrections, with a statement of the extent of experience upon which they are based, will be welcome.

It is not intended to state anything with rigid exactness. Dates of planting, time required for maturing, and quantities of seed are made to cover the extremes. In wheat and other grains both spring and winter are included in the range given. Kinds and quantities of manure are suggested, but, of course, only for locations where manure is needed. In several States hardly any manure is ever used. Kansas, Iowa, and South Dakota report no commercial fertilizers and very little manure in field operations. Prof. I. P. Roberts, of the Cornell experiment station, recently wrote in answer to an inquiry: "We have at this station long contended for better tillage and rational methods of applying farm manures and fertilizers. * * * We have proved with experiments extending over six years that far greater stress should be laid on tillage and that far less manure should be applied per acre for any one crop than is usually applied."

In any particular case the farmer must decide from the conditions before him whether manure is needed. The table will then give him some suggestion as to kind and quantity.

The yields and prices noted for cereals are based upon the tables for 1900, compiled by the Division of Statistics of this Department. The yields show the State averages for that year from the poorest up to the best. The varieties of seed noted are believed to represent those most common, but it is not known that a thorough investigation has ever been made. Indeed, changes of preference and use occur so frequently that only a special inquiry every year would give results nearly accurate.

Time of planting, quantity of seed, yield, prices, etc., for several regions.

NEW ENGLAND.

Kind of crop.	Date of planting.	Best soil.	Amount of manure per acre.	Amount of seed per acre.	Weeks to maturity.	Average yield per acre (bushels).	Range of price per bushel.	Standard varieties.
Corn	May 10 to 30	Sandy or clay loam	8 to 12 tons	8 to 12 qts.	14-17	32-40	$0.50-$0.67	Leaming, Sanford, Flint.
Wheat	Fall or spring	Clay loam	18 tons	2 bush	20	16-21	.77- .92	
Oats	Apr. to May	Strong loam	6 to 8 tons	2 to 3 bush.	11-15	31-38	.35- .38	White.
Barley	Apr. to June 20	....do	7 to 8 tons	....do	10-15	23-28	.52- .77	
Rye	Apr. to May, Sept.	Medium loam	....do	5 to 6 pecks	40	16-17	.65- .82	Do.
Buckwheat	June 1 to 20	Light loam	4 to 6 tons	1 to 1¼ bush.	10-15	16-30	.49- .72	
White beans	May to June	Sandy loam	7 to 8 tons	8 to 16 qts.	8-14	16-20	1.75- 2.50	
Potatoes	Apr. 15 to May 1	Rich loam	15 to 20 tons	8 to 20 bush.	12-20	80-350	.30- 1.25	Green Mountain, Carmen 3, Rose.
Turnips	July 1 to Aug. 3	Sandy loam	10 tons	1 lb	10	200-500	.05- .25	Yellow.
Mangels	Apr. 15 to May 5	Strong heavy loam	8 to 15 tons	4 to 6 lbs.	17-22	[a] 20-30	[c] 3.00	Long red, Sugar.
Tobacco	Seed bed Apr.	Sandy loam	8 to 12 tons		9-12	[b] 800-1,800	[d] .05- .50	
Hay								

MIDDLE STATES.

Kind of crop.	Date of planting.	Best soil.	Amount of manure per acre.	Amount of seed per acre.	Weeks to maturity.	Average yield per acre (bushels).	Range of price per bushel.	Standard varieties.
Corn	Apr. 20 to May 30	Medium loam	8 to 12 tons manure	6 to 8 qts.	16-18	24-33	$0.38-$0.47	Leaming, White Dent, Yellow Dent.
Wheat	Sept. 20 to Oct. 20	Loam	8 tons; 300 lbs. fer.	2 bush	41-43	14-20	.70- .82	Fultz.
Oats	Mar. to May	Moist clay loam	....do	2 to 2¼ bush.	16-17	21-31	.30- .32	White, Black.
Barley	....do	Clay loam	....do	....do	13-16	19-27	.50	Manshury.
Rye	Sept. 1 to Oct. 1	Sand or gravel loam	....do	1½ bush	40-43	15-16	.53- .56	White, Winter.
Buckwheat	June to July	Loam	5 tons	¾ to 1¼ bush.	8-10	13-16	.52- .59	Silver Hull.
White beans	May to June	Sandy loam	8 tons	1½ bush	13-14	20	.90- 1.25	Navy.
Potatoes	Mar. to May	Loam	10 to 18 tons	8 to 15 bush.	14-22	75-300	.30- .75	Rose, Carmen 3, Rural 2.
Sweet potatoes	May to June	Sandy loam		10 to 12 bush.	10-15	100-200	.25- 1.00	Yellow Jersey.
Cabbage	Mar. to July	Clay or sandy loam	300 to 600 lbs. fer.	4 to 8 oz	8-15		.01- .10	Dutch.
Turnips	July	Loam		2 to 5 lbs.	10-12	300	.15- .25	Purple top.
Mangels	May	....do	10 to 20 tons	10 to 15 bush.	15-18	23-28		Long red.
Flax	....do	Limestone loam		20 qts	8-10	10-12	.56	Rega, White Blossom, Dutch.
Tobacco	Seed bed, Mar	Sandy loam	Commercial fer.		15-20	[b] 1,000-1,500	[d] .04- .20	
Hay, timothy	Aug. to Oct.	Clay loam		6 to 8 qts.		[a] 1-2	10.00-16.00	
Hay, clover	Feb. to Apr.	....do		6 qts		[a] 1-3	8.00-12.00	Medium red.

Time of planting, quantity of seed, yield, prices, etc., for field crops—Continued.

CENTRAL AND WESTERN STATES.

Kind of crop.	Date of planting.	Best soil.	Amount of manure per acre.	Amount of seed per acre.	Weeks to maturity.	Average yield per acre (bushels).	Range of price per bushel.	Standard varieties.
Corn	Apr. 1 to June 1	Black or sandy loam	5 to 10 tons	6 qts	16-20	15-40	$0.26-$0.64	Leaming, Sanford, Flint White Dent.
Wheat	Fall or spring	Strong loam	8 tons	2 bush	40-42	6-27	.46- .79	Fultz, Poole, Fife.
Oats	Apr. 1 to May 1	Clay loam	do	2 to 3 bush	12-14	10-38	.20- .46	Gray Norway, Silver Mine, Russian.
Barley	Fall or spring[e]	do	do	2 bush	11-13	9-37	.31- .62	
Rye	Sept. 1 to 31	Light loam	do	1 to 2 bush	35-40	5-19	.39- .61	Winter.
Buckwheat	June	Clay loam	5 tons	do	10-12	13-16	.51- .77	Silver Hull.
White beans	May 10 to June 10	do	8 tons	1½ bush	12	14-25	.40- 1.00	Navy.
Potatoes	Mar. 15 to June 1	Sandy loam	5 to 10 tons	5 to 10 bush	10-20	80-300	.10- .70	Hebron, Rural, Early Rose, Early Ohio.
Turnips	July 15 to Aug. 30	Loam or muck	8 to 10 tons	1 to 6 lbs	10-16	500-700	.05- .25	
Mangels	Apr. 1 to May 15	Sandy loam	8 to 12 tons	6 to 8 lbs	22-24	500-1,000		
Flax	Mar. 15 to May 15	Loam	10 to 15 tons	2 to 3 pecks	15-20	10-18	.75- 1.50	
Tobacco	Seed bed, Mar	Sandy loam	8 to 10 tons	Oz. to 6 sq. rd	15-18	[b]600-1,000	[d].02- .20	Yellow Pryor, Spanish, White Burley.
Hay	Apr. to May	Clay loam	10 tons	8 to 15 lbs		[a]2-4		

SOUTHERN STATES.

Kind of crop.	Date of planting.	Best soil.	Amount of manure per acre.	Amount of seed per acre.	Weeks to maturity.	Average yield per acre (bushels).	Range of price per bushel.	Standard varieties.
Cotton	Feb. to May 15	Sandy loam[f]		1 to 3 bush	20-30	[b]100-500	$0.07-$0.09	Texas Storm Proof.
Corn	Feb. to June	Rich loams	10 bush. cot. seed	8 qts	18-20	7-27	.40- .64	Hickory King, Gourdseed, Cox Prolific.
Wheat	Sept. to Nov	Clay loam[f]	8 tons	2 bush	43	9-20	.64- 1.00	Fulcaster.
Oats	Feb., May, Sept	do	3 to 10 tons	2½ bush	17	11-38	.30- .50	Texas Rust-proof.
Barley	Apr. to May	do	do	do	17	15-29	.55- .72	Tennessee winter.
Rye	Sept. to Oct	do	10 tons	1½ bush	43	7-16.5	.52- 1.05	Excelsior winter.
White beans	Mar. to May	Light loam	8 tons	1 to 2 bush	7-8	90-100		Navy.
Cabbage	Oct., Mar. to May	do	6 to 10 tons	¼ to ½ lb	11	10	.01- .10	Wakefield, Flat Dutch, Charleston.
Watermelons	Mar. 1 to May 10	Rich, light loam	5 tons; 300 lbs. fer.	2 to 7 lbs	16-20			Jones, Rattlesnake.
Onions	Feb. 1 to Apr. 10	Loam or muck			16-24	300	1.75- 2.00	Red Potato.
Potatoes	Jan., Feb. to Apr	Light, loose loam	8 to 12 tons	8 to 10 bush	11-15	200-300	.60- 1.00	
Sweet potatoes	May to June	Sandy loam		10 to 12 bush	12-15	100-200	.25- 1.00	Yellow Jersey.
Pumpkins	Apr. 1 to May 1	Rich, light loam		4 to 7 lbs	17-20			
Tomatoes	Jan. 1 to Feb. 19	Rich, sandy loam		4 to 9 oz	14-20	400-600	1.00- 1.25	Crimson cushion, Ponderosa.
Turnips	Feb., Aug., Apr	Rich, light loam		2 to 6 lbs	8-12	[a]5		Purple top.
Tobacco	Seed bed, Mar	Sandy loam	8 to 15 tons	Oz. to 6 sq. rd	18-20	[b]600-1,000	[d].03- .20	
Cow peas	May 1 to July 15	do	200 to 300 lbs. phos.	2 to 5 pecks	6-8	10-20	.70- 1.75	Black, Whippoorwill.

[a] Tons. [b] Pounds. [c] Per ton. [d] Per pound. [e] Spring wheat is little grown in Ohio, Indiana, Illinois, and many other States. It matures in 18 to 20 weeks.
[f] In Texas the black loam is a good soil for cotton, corn, wheat, and most other field crops.

STATE STANDARDS FOR DAIRY PRODUCTS, 1902.

States.	Milk.			Skim milk.	Cream.	Butter.	Cheese.
	Total solids.	Solids not fat.	Fat.	Total solids.	Fat.	Fat.	Fat.
	Per cent.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per cent.*	
California	...	...	...	...	...	...	Full cream, 30 p. c. fat. Half skim, 15 p. c. fat. Skim, from skim milk. (Fancy cheese excepted.)
Colorado	...	...	...	...	...	...	Full cream, 35 p. c. total solids to be fat. Skim, fat less than 35 p. c. of total solids.
Dist. of Columbia	...	9	3.5	9.3	20	83 Not over 12 p. c. water or 5 p. c. salt.	
Georgia	...	8.5	3.5	Less than 3.5 p. c. fat or 8.5 p. c. solids not fat.			
Illinois [a]	12	...	3	...	[b]15	80	Whole milk, 48 p. c. total solids to be fat.
Indiana	...	9	3	...	...	80 Not over 15 p. c. water or 6 p. c. salt.	Skim milk, less than 10 p. c. fat.
Iowa	12.5	...	3	...	15	...	
Maine	12	...	3	...	...	...	
Massachusetts	13	9.3	3.7	9.3	...	...	
April-September	12	9	3	...	...	...	
Michigan	12.5	...	3	...	...	...	
	Sp. grav. 1.029-33	...	...	Sp. grav. 1.032-37	...	...	
Minnesota	13	...	3.5	...	20	...	Full cream, 45 p. c. total solids to be fat. Skim, fat less than 45 p. c. of total solids.
Missouri	...	...	...	...	...	...	Full cream, from 3 p. c. milk. Skim, from milk less than 3 p. c. fat.
Nebraska	...	...	3	...	15	...	
New Hampshire	13	...	...	...	...	...	
New Jersey	12	...	...	...	...	...	
New York [c]	12	...	3	...	...	...	Skim, from skim milk.
North Dakota	12	...	3	...	15	...	Do.
Ohio [c]	12	...	3	...	...	80	Full cream, 20 p. c. fat. Skim, less than 20 p. c. fat.
May and June	11.5	...	...	...	...	...	
Oregon [c]	12	8	3	Sp. grav 1.038	20	Not over 14 p. c. water.	40 p. c. total solids to be fat.
Pennsylvania (Milk and skim-milk standards refer to cities of second and third class.)	12.5 Sp. grav. 1.029-33	...	3	2.5 p. c. fat. 6 p. c. cream by vol. Sp grav. 1.032-37	...	...	Full cream, 32 p. c. fat. Three-fourths cream, 24 p. c. fat. One-half cream, 16 p. c. fat. One-fourth cream, 8 p. c. fat. Skim, below 8 p. c. fat. (Fancy cheese weighing less than 5 pounds excepted.)
Rhode Island	12	...	2.5	...	...	...	
South Carolina	...	8.5	3	Less than 3 p. c. fat or 8.5 p. c. solids not fat.	...	...	
South Dakota	...	...	...	...	...	...	Full cream, 45 p. c. total solids to be fat. Skim, fat less than 45 p. c. total solids.
Utah	...	...	...	9 p. c. solids not fat.	...	...	

[a] Condensed milk shall be made from milk containing at least the legal standard of 3 per cent butter fat and evaporated to one-third or less of its original volume.
[b] Coffee cream shall contain at least 15 per cent of fat, and whipping cream 22 per cent fat.
[c] In New York, Ohio, and Oregon the milk solids of condensed milk shall be in quantity the equivalent of 12 per cent of milk solids in crude milk, of which solids 25 per cent shall be fat.

STATE STANDARDS FOR DAIRY PRODUCTS, 1902—Continued.

States.	Milk.			Skim milk.	Cream.	Butter.	Cheese.
	Total solids.	Solids not fat.	Fat.	Total solids.	Fat.	Fat.	Fat.
	Per cent.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per cent.*	
Vermont	12.5	9.25		[a]4			
May and June	12						
Washington		8	3		18		Full cream, 30 p. c. fat. Skim, 15 p. c. fat. (Fancy cheese excepted.)
Wisconsin			3				Skim, size regulated.

[a] As basis for payment at factories.

BOARDS OF TRADE.

City and State.	Name of organization.	Secretary.
Baltimore, Md	Chamber of Commerce	W. F. Wheatley.
Boston, Mass	do	E. G. Preston.
Buffalo, N. Y	Merchants' Exchange	F. Howard Mason.
Chicago, Ill	Board of Trade	Geo. F. Stone.
Cincinnati, Ohio	Chamber of Commerce	Chas. B. Murray (supt.).
Cleveland, Ohio	do	F. A. Scott.
Columbus, Ohio	Board of Trade	J. Y. Bassell.
Denver, Colo	Chamber of Commerce and Board of Trade.	Arthur Williams.
Detroit, Mich	Board of Trade	F. W. Waring.
Duluth, Minn	do	S. A. Kemp.
Indianapolis, Ind	do	Jacob W. Smith.
Louisville, Ky	do	J. F. Buckner, jr.
Memphis, Tenn	Merchants' Exchange	N. S. Graves.
Milwaukee, Wis	Chamber of Commerce	W. J. Langson.
Minneapolis, Minn	Public Affairs Committee of Minneapolis Commercial Club.	W. G. Nye.
New York, N. Y	Produce Exchange	J. C. Brown (stat.).
Omaha, Nebr	Board of Trade	L. C. Harding.
Peoria, Ill	do	R. C. Grier.
Philadelphia, Pa	Commercial Exchange	A. D. Acheson.
Do	Produce Exchange	Howard Austin.
Portland, Oreg	Board of Trade	P. L. Willis.
Richmond, Va	Chamber of Commerce	R. A. Dunlop.
St. Louis, Mo	Merchants' Exchange	Geo. H. Morgan.
San Francisco, Cal	Chamber of Commerce	E. Scott.
Do	Merchants' Exchange	T. C. Friedlander.
Seattle, Wash	Chamber of Commerce	James B. Meikle.
Toledo, Ohio	Produce Exchange	Archibald Gassaway.
Washington, D. C	Board of Trade	Geo. H. Harries.

COTTON EXCHANGES.

City and State.	Name of organization.	Secretary.
Atlanta, Ga	Chamber of Commerce	W. G. Cooper.
Augusta, Ga	Exchange and Board of Trade	W. F. Alexander.
Birmingham, Ala	Commercial Club	J. B. Gibson.
Charleston, S. C	Cotton Exchange	René R. Jervey.
Columbia, S. C	Board of Trade	W. E. McNulty.
Columbus, Ga	Board of Trade	John C. Coart.
Dallas, Tex	Commercial Club	John G. Hunter.
Eufaula, Ala	Cotton Exchange	H. Lampley.
Fort Worth, Tex	Board of Trade	B. B. Paddock.
Galveston, Tex	Cotton Exchange and Board of Trade	S. O. Young.
Greenville, Miss	Cotton Exchange	Edw. Holland.
Greenwood, Miss	do	C. K. Marshall.
Houston, Tex	Cotton Exchange and Board of Trade	B. R. Warner.
Little Rock, Ark	Board of Trade	Geo. R. Brown.
Memphis, Tenn	Cotton Exchange	Henry Hotter.
Meridian, Miss	Cotton Exchange and Board of Trade	J. H. Stolzfus.
Mobile, Ala	Cotton Exchange	R. H. Bolling.
Monroe, La	Board of Trade	E. D. Windes.
Montgomery, Ala	Commercial and Industrial Association	L. L. Gilbert.
Nashville, Tenn	Chamber of Commerce	L. R. Eastman.
Natchez, Miss	Cotton and Merchants' Exchange	W. E. Fitzpatrick.
Newbern, N. C	Cotton and Grain Exchange	James Redmond.
New Orleans, La	Cotton Exchange	H. G. Hester.
New York, N. Y	do	Robt. P. McDougall.

COTTON EXCHANGES—Continued.

City and State.	Name of organization.	Secretary.
Norfolk and Portsmouth, Va.	Cotton Exchange	Norman Bell.
Raleigh, N. C.	Cotton and Grocers' Exchange	P. T. Wyatt.
Richmond, Va.	Grain and Cotton Exchange	B. A. Jacob.
Rome, Ga.	Board of Trade	A. W. Walton.
St. Louis, Mo.	Merchants' Exchange	Geo. H. Morgan.
Savannah, Ga.	Cotton Exchange	J. P. Merrihew.
Selma, Ala	....do	C. A. McKinnon.
Sherman, Tex.	Commercial Club	W. A. Murphy.
Shreveport, La	Board of Trade	Henry Hawkins.
Texarkana, Ark.	Commercial Club	J. F. Black.
Vicksburg, Miss	Cotton Exchange	J. H. Cook.
Waco, Tex.	Business Men's Club	Lewin Plunkett.
Wilmington, N. C.	Produce Exchange	John L. Cantwell.
Yazoo City, Miss.	Cotton Exchange	L. Bowman.

STATISTICS OF THE PRINCIPAL CROPS.[a]

CORN.

The average prices of corn ranged higher in 1901 than during any year since 1891. The visible supply the first of each month was largest in April, 28,947,000 bushels, and gradually decreased to 16,599,000 bushels on December 1. Wholesale prices of cash corn in Chicago averaged higher in 1901 than during any year since 1892, the low point being in January and the high in December, and the range for the year being about 29 cents. Cash corn in Chicago market sold in January at 36 cents, advanced to 58½ cents in May, reacted to 41 cents in June, recovered to 59¾ cents in September, off to 54⅝ cents in October, and sold at the top figure, 67½ cents in December.

Corn crop of the world, 1896–1900.

Countries.	1896.	1897.	1898.	1899.	1900.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States	2,283,875,000	1,902,968,000	1,924,185,000	2,078,144,000	2,105,103,000
Canada (Ontario)	24,830,000	25,441,000	24,181,000	22,356,000	27,947,000
Mexico	76,264,000	121,893,000	111,347,000	93,438,000	100,000,000
Total North America	2,384,969,000	2,050,302,000	2,059,713,000	2,193,938,000	2,233,050,000
Chile	9,000,000	8,000,000	9,932,000	9,000,000	8,000,000
Argentina	80,000,000	40,000,000	56,000,000	72,000,000	60,000,000
Uruguay	5,000,000	4,000,000	4,000,000	6,000,000	3,035,000
Total South America	94,000,000	52,000,000	69,932,000	87,000,000	71,035,000
France	30,426,000	30,401,000	23,496,000	25,548,000	22,232,000
Spain	18,252,000	19,641,000	14,098,000	24,667,000	24,000,000
Portugal	15,000,000	15,500,000	15,500,000	16,000,000	16,000,000
Italy	79,910,000	65,891,000	79,640,000	88,536,000	83,286,000
Austria	17,492,000	14,757,000	16,074,000	14,583,000	15,446,000
Hungary	128,866,000	103,910,000	127,382,000	115,981,000	127,656,000
Croatia-Slavonia	17,617,000	14,608,000	20,822,000	14,680,000	18,691,000
Total Austria-Hungary	163,975,000	133,275,000	164,278,000	145,214,000	161,793,000
Roumania	65,428,000	79,753,000	101,907,000	27,721,000	84,730,000
Bulgaria and E. Roumelia	26,400,000	25,000,000	37,759,000	20,462,000	36,000,000
Servia	16,000,000	16,000,000	24,558,000	15,000,000	24,000,000
Russia	23,773,000	51,966,000	47,918,000	30,912,000	34,256,000
Total Europe	439,164,000	437,430,000	509,154,000	394,090,000	486,297,000
Algeria	451,000	301,000	347,000	349,000	350,000
Egypt	34,000,000	35,000,000	32,000,000	30,000,000	20,000,000
Cape Colony	1,650,000	2,761,000	2,061,000	2,858,000	2,000,000
Total Africa	36,101,000	38,062,000	34,408,000	33,207,000	22,350,000
Australasia	10,201,000	9,412,000	9,780,000	10,025,000	10,168,000

[a] The figures in the following tables were furnished by the Division of Statistics, Department of Agriculture, except such as otherwise credited. All prices are on gold basis.

Corn crop of the world, 1896-1900—Continued.

RECAPITULATION BY CONTINENTS.

Countries.	1896.	1897.	1898.	1899.	1900.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
North America	2,384,969,000	2,050,302,000	2,059,713,000	2,193,938,000	2,233,050,000
South America	94,000,000	52,000,000	69,932,000	87,000,000	71,035,000
Europe	439,164,000	437,430,000	509,154,000	394,090,000	486,297,000
Africa	36,101,000	38,062,000	34,408,000	33,207,000	22,350,000
Australasia	10,201,000	9,412,000	9,780,000	10,025,000	10,168,000
Total	2,964,435,000	2,587,206,000	2,682,987,000	2,718,260,000	2,822,900,000

Visible supply of corn in the United States first of each month for ten years. [a]

Month.	1892-1893.	1893-1894.	1894-1895.	1895-1896.	1896-1897.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	9,480,000	10,151,000	7,793,000	10,762,000	11,199,000
August	8,897,000	9,995,000	4,816,000	5,770,000	13,246,000
September	8,780,000	6,996,000	4,295,000	6,819,000	18,608,000
October	12,265,000	9,986,000	5,206,000	6,760,000	17,800,000
November	15,188,000	11,318,000	3,353,000	6,338,000	23,913,000
December	12,616,000	9,412,000	6,380,000	7,381,000	22,635,000
January	13,523,000	11,335,000	12,882,000	9,164,000	26,457,000
February	14,455,000	19,183,000	16,733,000	17,035,000	29,725,000
March	18,037,000	22,758,000	17,001,000	17,040,000	33,764,000
April	17,236,000	21,362,000	16,330,000	19,290,000	32,670,000
May	13,025,000	14,881,000	11,602,000	13,239,000	21,707,000
June	9,497,000	9,555,000	12,629,000	11,231,000	16,161,000

Month.	1897-1898.	1898-1899.	1899-1900.	1900-1901.	1901-1902.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	21,501,000	32,983,000	21,551,000	19,087,000	21,522,000
August	20,018,000	25,430,000	17,687,000	18,613,000	19,648,000
September	37,528,000	24,043,000	11,070,000	8,766,000	19,476,000
October	45,412,000	30,132,000	16,662,000	11,106,000	21,215,000
November	52,980,000	33,198,000	18,738,000	11,061,000	19,137,000
December	49,559,000	25,870,000	17,555,000	12,791,000	16,599,000
January	48,292,000	26,936,000	19,024,000	14,313,000	16,825,000
February	53,522,000	36,726,000	20,110,000	21,950,000	17,197,000
March	52,457,000	44,792,000	28,340,000	27,538,000	15,270,000
April	52,228,000	43,618,000	31,883,000	28,947,000	13,540,000
May	34,734,000	34,236,000	30,416,000	24,544,000	9,093,000
June	28,288,000	19,070,000	18,289,000	21,904,000	....

[a] These figures represent stocks available at 62 of the principal points of accumulation east of the Rocky Mountains, stocks in Manitoba elevators, and stocks afloat on lakes and canals.

Condition of the corn crop of the United States, monthly, 1887-1901.

Year.	July.	Aug.	Sept.	Oct.	Year.	July.	Aug.	Sept.	Oct.	Year.	July.	Aug.	Sept.	Oct.
1887	97.7	80.5	72.3	72.8	1892	81.1	82.5	79.6	79.8	1897	82.9	84.2	79.3	77.1
1888	93.0	95.5	94.2	92.0	1893	93.2	87.0	76.7	75.1	1898	90.5	87.0	84.1	82.0
1889	90.3	94.8	90.9	91.7	1894	95.0	69.1	63.4	64.2	1899	86.5	89.9	85.2	82.7
1890	93.1	73.3	70.1	70.6	1895	99.3	102.5	96.4	95.5	1900	89.5	87.5	80.6	78.2
1891	92.8	90.8	91.1	92.5	1896	92.4	96.0	91.0	90.5	1901	81.3	54.0	51.7	52.1

Acreage, production, value, prices, and exports of corn of the United States, 1866–1901.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel. Dec. 1.	Farm value, Dec. 1.	Chicago cash price per bushel, No. 2. December. Low.	December. High.	May of following year. Low.	May of following year. High.	Domestic exports, including corn meal, fiscal years beginning July 1.
	Acres.	*Bush.*	*Bushels.*	*Cents.*	*Dollars.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Bushels.*
1866	34,306,538	25.3	867,946,295	47.4	411,450,830	53	62	64	79	16,026,947
1867	32,520,249	23.6	768,320,000	57.0	437,769,763	61	65	61	71	12,493,522
1868	34,887,246	26.0	906,527,000	46.8	424,056,649	38	58	44	51	8,286,665
1869	37,103,245	23.6	874,320,000	59.8	522,550,509	56	67	73	85	2,140,487
1870	38,646,977	28.3	1,094,255,000	49.4	540,520,456	41	59	46	52	10,676,873
1871	34,091,137	29.1	991,898,000	43.4	430,355,910	36	39	38	43	35,727,010
1872	35,526,836	30.8	1,092,719,000	35.3	385,736,210	27	28	34	39	40,154,374
1873	39,197,148	23.8	932,274,000	44.2	411,961,151	40	49	49	59	35,985,834
1874	41,036,918	20.7	850,148,500	58.4	496,271,255	64	76	53	67	30,025,036
1875	44,841,371	29.5	1,321,069,000	36.7	484,674,804	40	47	41	45	50,910,532
1876	49,033,364	26.2	1,283,827,500	34.0	436,108,521	40	43	43	56	72,652,611
1877	50,369,113	26.7	1,342,558,000	34.8	467,635,230	41	49	35	41	87,192,110
1878	51,585,000	26.9	1,388,218,750	31.7	440,280,517	30	32	33	36	87,884,892
1879	53,085,450	29.2	1,547,901,790	37.5	580,486,217	39	43¼	32⅝	36⅛	99,572,329
1880	62,317,842	27.6	1,717,434,543	39.6	679,714,499	35⅝	42	41⅛	45	93,648,147
1881	64,262,025	18.6	1,194,916,000	63.6	759,482,170	58⅛	63⅛	69	76⅞	44,340,683
1882	65,659,545	24.6	1,617,025,100	48.5	783,867,175	49¼	61	53¼	56¾	41,655,653
1883	68,301,889	22.7	1,551,066,895	42.4	658,051,485	·54¼	63⅛	52⅛	57	46,258,606
1884	69,683,780	25.8	1,795,528,000	35.7	640,735,560	34⅛	40¼	44¾	49	52,876,456
1885	73,130,150	26.5	1,936,176,000	32.8	635,674,630	36	42¾	34¼	36¾	64,829,617
1886	75,694,208	22.0	1,665,441,000	36.6	610,311,000	35¾	38	36⅞	39⅝	41,368,584
1887	72,392,720	20.1	1,456,161,000	44.4	646,106,770	47	51⅝	54	60	25,360,869
1888	75,672,763	26.3	1,987,790,000	34.1	677,561,580	33⅛	35⅞	33⅛	35⅝	70,841,673
1889	78,319,651	27.0	2,112,892,000	28.3	597,918,829	29¼	35	32¾	35	103,418,709
1890	71,970,763	20.7	1,489,970,000	50.6	754,433,451	47¾	53	55	69⅛	32,041,529
1891	76,204,515	27.0	2,060,154,000	40.6	836,439,228	39⅛	59	40¾	[a]100	76,602,285
1892	70,626,658	23.1	1,628,464,000	39.4	642,146,630	40	42⅞	39⅛	44⅛	47,121,894
1893	72,036,465	22.5	1,619,496,131	36.5	591,625,627	34¼	36⅛	36¾	38⅛	66,489,529
1894	62,582,269	19.4	1,212,770,052	45.7	554,719,162	44¾	47⅛	47¾	55⅛	28,585,405
1895	82,075,830	26.2	2,151,138,580	25.3	544,985,534	25	26¾	27⅛	29⅛	101,100,375
1896	81,027,156	28.2	2,283,875,165	21.5	491,006,967	22⅛	23¾	23	25⅛	178,817,417
1897	80,095,051	23.8	1,902,967,933	26.3	501,072,952	25	27⅛	32⅝	37	212,055,543
1898	77,721,781	24.8	1,924,184,660	28.7	552,023,428	33⅛	38	32⅛	34⅝	177,255,046
1899	82,108,587	25.3	2,078,143,933	30.3	629,210,110	30	31⅛	36	40⅛	213,123,412
1900	83,320,872	25.3	2,105,102,516	35.7	751,220,034	35¼	40⅛	42⅝	58⅛	181,405,473
1901	91,349,928	16.7	1,522,519,891	60.5	921,555,768	62⅛	66⅝	......	......	....

[a] Coincident with "corner."

Acreage, production, value, and distribution of corn of the United States, in 1901, by States.

States and Territories.	Crop of 1901. Acreage.	Crop of 1901. Production.	Crop of 1901. Value.	Stock on hand Mar. 1, 1902.		Shipped out of county where grown.
	Acres.	*Bushels.*	*Dollars.*	*Bushels.*	*Per cent.*	*Bushels.*
Maine	13,267	522,720	397,267	135,907	26	0
New Hampshire	26,631	1,025,294	799,729	348,600	34	0
Vermont	57,147	2,285,880	1,668,692	845,776	37	0
Massachusetts	43,617	1,766,488	1,342,531	476,952	27	0
Rhode Island	9,470	303,987	231,030	106,395	35	3,040
Connecticut	49,004	1,911,156	1,433,367	554,235	29	0
New York	626,437	20,672,421	14,884,143	6,615,175	32	413,448
New Jersey	278,829	10,288,790	6,790,601	3,909,740	38	1,337,543
Pennsylvania	1,457,238	51,003,330	31,622,065	19,381,265	38	2,040,133
Delaware	185,281	5,558,430	3,168,305	2,223,372	40	1,834,282
Maryland	622,754	21,298,187	12,352,948	8,732,257	41	4,898,583
Virginia	1,842,498	40,903,456	24,133,039	16,361,382	40	3,681,311
North Carolina	2,553,474	30,641,688	22,368,432	11,031,008	36	1,225,668
South Carolina	1,722,488	11,885,167	9,983,540	3,446,698	29	118,852
Georgia	3,785,758	37,857,580	31,043,216	14,764,456	39	1,135,727
Florida	579,231	5,213,079	4,431,117	1,980,970	38	0
Alabama	2,559,923	27,903,161	21,485,434	10,882,233	39	558,063
Mississippi	2,061,755	22,473,120	16,630,109	6,292,474	28	0
Louisiana	1,316,452	18,035,392	13,526,544	4,508,848	25	180,354
Texas	5,176,810	60,050,996	48,040,797	12,010,199	20	600,510
Arkansas	2,308,904	18,702,122	15,148,719	3,366,382	18	187,021
Tennessee	3,178,140	45,129,588	29,334,232	16,246,652	36	3,610,367
West Virginia	744,289	17,118,647	11,127,121	5,306,781	31	855,932
Kentucky	3,177,896	49,575,178	30,240,859	16,359,809	33	1,983,007
Ohio	3,077,138	80,313,302	45,778,582	24,093,991	30	14,456,394
Michigan	1,319,900	45,536,550	23,679,006	14,571,696	32	5,464,386
Indiana	4,431,997	87,753,541	48,264,448	27,203,598	31	14,010,567

Acreage, production, value, and distribution of corn of the United States, in 1901, by States—Continued.

States and Territories.	Crop of 1901.			Stock on hand Mar. 1, 1902.		Shipped out of county where grown.
	Acreage.	Production.	Value.			
	Acres.	*Bushels.*	*Dollars.*	*Bushels.*	*Per cent.*	*Bushels.*
Illinois	9,253,538	198,025,713	112,874,656	59,407,714	30	35,641,628
Wisconsin	1,460,626	40,021,152	20,810,999	9,204,865	23	800,423
Minnesota	1,361,120	35,797,456	16,108,855	10,023,288	28	3,221,771
Iowa	9,210,582	230,264,550	119,737,566	71,382,010	31	23,026,455
Missouri	6,577,859	66,436,376	44,512,372	11,958,548	18	1,328,728
Kansas	7,885,389	61,506,034	38,748,801	8,610,845	14	615,060
Nebraska	7,740,556	109,141,840	58,936,594	26,194,042	24	20,736,950
South Dakota	1,421,079	29,842,659	13,429,197	10,146,504	34	8,654,371
North Dakota	67,236	1,519,534	698,986	288,711	19	0
Montana	3,095	77,375	69,638	6,190	8	0
Wyoming	2,207	87,176	62,767	8,718	10	0
Colorado	107,127	1,831,872	1,355,585	366,374	20	256,462
New Mexico	36,544	1,154,790	889,188	219,410	19	46,192
Arizona	9,871	177,678	159,910	24,875	14	0
Utah	10,919	211,829	190,646	33,893	16	8,473
Idaho	5,091	117,093	70,256	23,419	20	0
Washington	9,818	171,815	99,653	34,363	20	1,718
Oregon	16,711	347,589	198,126	27,807	8	3,476
California	59,703	1,850,793	1,258,539	277,619	15	37,016
Oklahoma	1,414,262	10,324,113	7,846,326	1,135,652	11	206,482
Indian Territory	1,490,267	17,883,204	13,591,235	2,324,817	13	0
United States	91,349,928	1,522,519,891	921,555,768	443,456,515	29.1	153,213,393

Average yield per acre of corn in the United States, 1892–1901, by States.

States and Territories.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
	Bush.	*Bush.*	*Bush.*	*Bush*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	35.5	30.3	39.9	42.0	37.0	37.0	40.0	36.0	36.0	39.4
New Hampshire	37.8	31.7	34.3	40.2	42.0	34.0	41.0	39.0	37.0	38.5
Vermont	38.0	32.4	40.8	45.6	41.0	35.0	43.0	36.0	40.0	40.0
Massachusetts	38.7	33.5	34.5	43.9	43.0	32.5	40.0	36.0	38.0	40.5
Rhode Island	33.4	24.4	31.4	30.9	34.0	31.0	34.0	31.0	32.0	32.1
Connecticut	34.5	28.2	31.0	37.9	38.0	31.5	37.0	39.0	38.0	39.0
New York	33.0	29.5	28.2	35.6	34.0	31.0	33.0	31.0	32.0	33.0
New Jersey	31.6	25.9	33.1	33.0	33.0	31.5	37.0	39.0	33.0	36.9
Pennsylvania	30.5	24.5	32.0	33.5	40.0	36.0	37.0	32.0	25.0	35.0
Delaware	18.7	24.6	22.0	21.0	22.0	29.0	25.0	22.0	24.0	30.0
Maryland	20.6	24.2	22.9	26.8	32.0	33.0	31.0	32.0	26.0	34.2
Virginia	15.3	18.9	19.1	18.6	21.5	18.0	22.0	20.0	16.0	22.2
North Carolina	10.2	12.3	13.4	14.5	12.0	13.0	14.0	13.0	12.0	12.0
South Carolina	10.5	7.7	11.2	11.1	9.0	9.0	10.0	9.0	7.0	6.9
Georgia	11.2	11.1	11.7	13.0	11.0	11.0	9.0	10.0	10.0	10.0
Florida	9.0	9.7	10.1	11.2	10.0	8.0	9.0	10.0	8.0	9.0
Alabama	12.2	11.5	13.7	15.9	12.5	12.0	15.0	12.0	11.0	10.9
Mississippi	13.7	13.1	17.2	15.8	13.5	14.5	18.0	16.0	11.0	10.9
Louisiana	14.8	14.2	16.2	18.8	13.0	17.0	18.0	18.0	17.0	13.7
Texas	21.4	17.6	19.0	26.4	9.5	18.5	25.0	18.0	18.0	11.6
Arkansas	17.5	16.2	19.2	21.5	13.5	16.0	20.0	20.0	19.0	8.1
Tennessee	20.3	21.3	21.9	25.0	23.0	21.0	26.0	20.0	20.0	14.2
West Virginia	22.5	21.7	18.5	24.2	30.0	24.5	29.0	26.0	27.0	23.0
Kentucky	23.3	23.5	23.0	31.2	28.0	23.0	31.0	21.0	26.0	15.6
Ohio	29.4	23.8	26.3	32.6	41.0	32.5	37.0	30.0	37.0	26.1
Michigan	25.0	23.7	23.2	33.8	38.0	31.5	34.0	25.0	36.0	34.5
Indiana	29.3	24.7	28.9	32.8	35.0	30.0	36.0	38.0	38.0	19.8
Illinois	26.2	25.7	28.8	37.4	40.5	32.5	30.0	36.0	37.0	21.4
Wisconsin	27.3	29.8	20.7	31.8	37.0	33.0	35.0	35.0	40.0	27.4
Minnesota	27.0	28.3	18.4	31.2	30.5	26.0	32.0	33.0	33.0	26.3
Iowa	28.3	33.9	15.0	35.1	39.0	29.0	35.0	31.0	38.0	25.0
Missouri	27.7	27.9	22.0	36.0	27.0	26.0	26.0	26.0	28.0	10.1
Kansas	24.5	21.3	11.2	24.3	28.0	18.0	16.0	27.0	19.0	7.8
Nebraska	28.2	25.2	6.0	16.1	37.5	30.0	21.0	28.0	26.0	14.1
South Dakota	22.3	23.7	4.2	11.1	26.0	24.0	28.0	26.0	27.0	21.0
North Dakota	21.4	20.7	19.2	21.3	35.0	17.0	19.0	23.0	16.0	22.6
Montana	19.4	27.5	32.7	25.0	26.0	18.0	28.0	23.0	15.0	25.0
Wyoming	18.5	18.5	30.0	27.5	25.0	12.0	16.0	22.0	34.0	39.5
Colorado	22.3	16.5	19.7	20.7	16.0	19.0	18.0	17.0	19.0	17.1
New Mexico	20.0	25.3	19.1	27.2	16.0	27.0	21.0	20.0	22.0	31.6
Arizona	......	......	......	......	......	......	......	......	......	18.0
Utah	18.0	21.5	24.4	20.3	25.0	22.0	21.0	20.0	20.0	19.4
Idaho	......	......	......	......	......	......	......	......	......	23.0
Washington	18.0	21.3	20.8	17.1	14.0	18.0	12.0	23.0	20.0	17.5
Oregon	21.5	24.7	25.4	26.4	22.0	25.0	24.0	22.0	23.0	20.8
California	30.3	31.7	19.3	34.5	37.0	31.5	26.0	27.0	25.0	31.0
Oklahoma	......	......	......	......	......	......	......	19.0	26.0	7.3
Indian Territory	......	......	......	......	......	......	......	......	......	12.0
General average	23.06	22.48	19.38	26.21	28.19	23.76	24.76	25.31	25.3	16.7

Average value per acre of corn in the United States, 1892–1901, by States.

States and Territories.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
Maine	$23.79	$18.79	$28.73	$22.68	$17.39	$17.39	$19.20	$18.00	$19.80	$29.94
New Hampshire	24.57	18.07	26.07	20.50	18.90	15.30	18.86	19.11	20.72	30.03
Vermont	24.32	19.76	28.15	21.89	15.58	15.05	18.92	16.92	20.00	29.20
Massachusetts	23.99	20.77	21.05	22.83	19.78	15.28	19.60	18.36	20.52	30.78
Rhode Island	21.04	16.84	23.55	17.30	16.66	16.74	21.76	16.43	21.44	24.40
Connecticut	21.39	18.05	21.08	19.33	15.96	15.43	19.24	19.50	20.90	29.25
New York	19.80	16.23	17.20	16.02	12.92	12.40	14.19	13.95	15.04	23.76
New Jersey	18.33	13.47	17.87	13.86	11.88	11.97	14.80	15.60	14.85	24.35
Pennsylvania	17.38	12.00	17.60	13.07	13.26	22.24	14.80	13.12	11.25	21.70
Delaware	8.23	9.84	9.90	7.14	5.50	8.70	7.75	7.48	9.12	17.10
Maryland	9.27	10.64	11.45	9.92	10.24	9.90	10.85	11.52	10.66	19.84
Virginia	8.11	8.69	8.98	6.88	6.88	6.84	7.70	7.60	7.84	13.10
North Carolina	5.51	6.15	6.30	5.51	4.44	5.59	6.02	6.11	6.84	8.76
South Carolina	5.99	4.62	7.28	5.11	4.14	4.41	4.60	4.50	4.48	5.80
Georgia	6.27	6.22	6.79	5.33	4.73	5.28	4.32	5.00	5.70	8.20
Florida	5.40	6.60	7.17	5.26	5.30	4.40	4.50	5.30	4.80	7.65
Alabama	6.34	6.79	7.26	5.88	5.63	5.52	6.15	5.64	6.38	8.39
Mississippi	6.99	7.20	8.43	5.85	5.94	6.53	7.02	7.36	6.38	8.07
Louisiana	7.40	8.09	10.04	7.24	5.85	7.65	7.38	7.92	8.50	10.27
Texas	9.63	9.50	10.64	8.18	3.90	7.58	8.50	6.48	8.46	9.28
Arkansas	8.23	7.29	9.02	6.88	4.99	6.40	5.80	7.60	8.17	6.56
Tennessee	8.73	8.31	8.54	6.75	6.44	7.56	7.54	7.80	9.80	9.23
West Virginia	12.60	11.94	10.55	9.68	10.20	9.80	10.73	11.70	13.50	14.95
Kentucky	9.32	10.11	10.12	8.42	7.00	8.05	8.37	7.77	10.40	9.52
Ohio	12.35	9.52	11.31	8.80	8.61	8.12	9.99	10.80	12.58	14.88
Michigan	11.50	10.66	11.60	10.82	9.12	8.50	11.56	9.00	13.32	17.94
Indiana	11.72	8.89	10.69	7.54	6.65	6.30	9.00	10.26	12.16	10.89
Illinois	9.69	7.97	11.23	8.23	7.29	6.83	7.50	9.36	11.84	12.20
Wisconsin	10.37	10.43	9.32	9.54	8.14	8.25	9.80	10.50	13.20	14.25
Minnesota	9.99	9.62	7.91	6.24	5.79	6.24	7.68	7.92	9.57	11.83
Iowa	9.06	9.15	6.75	6.32	5.46	4.93	8.05	7.13	10.26	13.00
Missouri	9.97	8.37	8.80	7.20	5.40	6.24	7.02	7.80	8.96	6.77
Kansas	7.60	6.60	4.82	4.62	5.04	3.96	4.16	6.75	6.08	4.91
Nebraska	7.90	6.80	8.00	2.90	4.88	5.10	4.62	6.44	8.06	7.61
South Dakota	7.36	5.93	1.93	2.55	4.68	5.04	6.44	6.76	7.83	9.45
North Dakota	8.56	7.87	8.45	5.11	8.75	5.44	6.84	7.59	6.72	10.40
Montana	13.30	19.25	26.81	18.75	15.60	11.70	18.48	11.96	8.85	22.50
Wyoming	11.28	11.66	19.50	15.67	19.50	6.00	8.80	9.46	20.40	28.44
Colorado	8.92	8.42	12.02	8.49	5.76	7.22	7.20	7.31	9.12	12.65
New Mexico	14.40	17.96	14.33	15.23	8.80	15.66	11.76	11.60	14.08	24.33
Arizona	......	......	......	......	......	......	......	......	......	16.20
Utah	10.44	12.47	14.15	9.95	12.75	12.10	12.60	11.80	12.60	17.46
Idaho	......	......	......	......	......	......	......	......	......	13.80
Washington	10.80	13.21	14.35	6.84	7.98	9.90	5.04	12.65	11.80	10.15
Oregon	12.04	11.61	14.22	14.52	12.32	13.25	14.40	14.08	13.11	11.86
California	16.67	15.85	11.00	18.29	19.61	17.64	16.12	16.20	15.25	21.08
Oklahoma	......	......	......	......	......	......	......	3.80	6.76	5.55
Indian Territory	......	......	......	......	......	......	......	......	......	9.12
General average	9.09	8.21	8.86	6.64	6.06	6.26	7.10	7.66	9.02	10.09

Use of cornstalks as forage in the United States in 1899.

[From the Twelfth Census of the United States.]

States.	Number of farms reporting.	Tons.	States.	Number of farms reporting.	Tons.
The United States	689,915	4,759,369	Missouri	21,517	264,697
Alabama	46,351	72,847	Montana	5	93
Arizona	17	327	Nebraska	911	15,115
Arkansas	7,638	16,800	New Hampshire	248	1,708
California	34	716	New Jersey	3,779	77,659
Colorado	261	3,990	New Mexico	381	1,221
Connecticut	1,101	7,856	New York	8,295	70,021
Delaware	3,475	48,890	North Carolina	98,328	183,004
Florida	9,751	14,806	North Dakota	27	823
Georgia	77,424	136,924	Ohio	32,658	563,149
Idaho	3	29	Oklahoma	518	8,159
Illinois	14,567	307,648	Oregon	70	486
Indiana	38,039	564,770	Pennsylvania	24,964	253,554
Indian Territory	197	3,330	Rhode Island	193	1,510
Iowa	12,155	251,702	South Carolina	65,426	104,363
Kansas	5,459	168,465	South Dakota	237	5,382
Kentucky	14,932	121,468	Tennessee	32,529	123,270
Louisiana	6,382	85,158	Texas	9,134	27,853
Maine	600	2,652	Utah	119	902
Maryland	5,709	91,845	Vermont	660	6,375
Massachusetts	940	7,655	Virginia	61,332	315,100
Michigan	18,675	225,480	Washington	37	516
Minnesota	5,435	72,339	West Virginia	14,936	103,451
Mississippi	21,262	35,518	Wisconsin	23,401	392,043

Average farm price of corn per bushel in the United States, December 1, 1892–1901, by States.

States and Territories.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	67	62	72	54	47	47	48	50	55	76
New Hampshire	65	57	76	51	45	45	46	49	56	78
Vermont	64	61	69	48	38	43	44	47	50	73
Massachusetts	62	62	61	52	46	47	49	51	54	76
Rhode Island	63	69	75	56	49	54	64	53	67	76
Connecticut	62	64	68	51	42	49	52	50	55	75
New York	60	55	61	45	38	40	43	45	47	72
New Jersey	58	52	54	42	36	38	40	40	45	66
Pennsylvania	57	49	55	39	33	34	40	41	45	62
Delaware	44	40	45	34	25	30	31	34	38	57
Maryland	45	44	50	37	32	30	35	36	41	58
Virginia	53	46	47	37	32	38	35	38	49	59
North Carolina	54	50	47	38	37	43	43	47	57	73
South Carolina	57	60	65	46	46	49	46	50	64	84
Georgia	56	56	58	41	43	48	48	50	57	82
Florida	60	68	71	47	53	55	50	53	60	85
Alabama	52	59	53	37	45	46	41	47	58	77
Mississippi	51	55	49	37	44	45	39	46	58	74
Louisiana	50	57	62	40	45	45	41	44	50	75
Texas	45	54	56	31	41	41	34	36	47	80
Arkansas	47	45	47	32	37	40	29	38	43	81
Tennessee	43	39	39	27	28	36	29	39	49	65
West Virginia	56	55	57	40	34	40	37	45	50	65
Kentucky	40	43	44	27	25	35	27	37	40	61
Ohio	42	40	43	27	21	25	27	30	34	57
Michigan	46	45	50	32	24	27	34	36	37	52
Indiana	40	36	37	23	19	21	25	27	32	55
Illinois	37	31	39	22	18	21	25	26	32	57
Wisconsin	38	35	45	30	22	25	28	30	33	52
Minnesota	37	34	43	20	19	24	24	24	29	45
Iowa	32	27	45	18	14	17	23	23	27	52
Missouri	36	30	40	20	20	24	27	30	32	67
Kansas	31	31	43	19	18	22	26	25	32	63
Nebraska	28	27	50	18	13	17	22	23	31	54
South Dakota	33	25	46	23	18	21	23	26	29	45
North Dakota	40	38	44	24	25	32	36	33	42	46
Montana	70	70	82	75	60	65	66	52	59	90
Wyoming	61	63	65	57	78	50	55	43	60	72
Colorado	40	51	61	41	36	38	40	43	48	74
New Mexico	72	71	75	56	55	58	56	58	64	77
Arizona	......	......	......	......	......	......	......	......	......	90
Utah	58	58	58	49	51	55	60	59	63	90
Idaho	......	......	......	......	......	......	......	......	......	60
Washington	60	62	69	40	57	55	42	55	59	58
Oregon	56	47	56	55	56	53	60	64	57	57
California	55	50	57	53	53	56	62	60	61	68
Oklahoma	......	......	......	......	......	......	......	20	26	76
Indian Territory	......	......	......	......	......	......	......	......	......	76
General average	39.43	36.53	45.71	25.33	21.50	26.33	28.69	30.28	35.70	60.5

Transportation rates, average for corn, in cents, St. Louis to New Orleans by river.

Year.	Per bushel.		Year.	Per bushel.		Sacks per 100 lbs.	Year.	Per bushel.		Sacks per 100 lbs.	Year.	Sacks per 100 lbs.
	Low water.	High water.		Low water.	High water.			Low water.	High water.			
1866	9.05	10.93	1875	4.87	10.01	......	1884	5.00	7.00	14.00	1893	17.54
1867	11.09	14.83	1876	5.02	11.30	......	1885	5.00	7.00	15.00	1894	17.14
1868	6.23	9.84	1877	7.63	8.59	20.04	1886	5.00	7.00	16.00	1895	12.50
1869	6.32	8.42	1878	4.96	8.93	17.36	1887	5.00	7.00	18.25	1896	14.55
1870	9.23	13.66	1879	5.00	11.00	18.00	1888	5.00	7.50	15.00	1897	15.00
1871	6.71	16.29	1880	7.00	9.50	19.00	1889	5.00	7.00	17.93	1898	10.00
1872	9.79	19.04	1881	4.00	8.00	20.00	1890	5.00	7.00	15.66	1899	10.00
1873	6.15	9.67	1882	5.50	7.00	20.00	1891	5.00	7.50	16.07	1900	10.00
1874	4.95	8.09	1883	5.00	7.00	17.75	1892	5.00	7.00	16.87	1901	10.00

Wholesale prices of corn per bushel in leading cities of the United States, 1896–1901.

Date.	New York.		Baltimore.		Cincinnati.		Chicago.		Detroit.		St. Louis.		San Franc.	
	No. 2.		No. 2.		No. 2.		No. 2.		No. 2.		No. 2.		No. 1, white (per cwt.).	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*		
1896.														
January	34⅝	37	31¾	34	27½	30	25½	28¼	27½	29¼	23⅞	26⅝	$0.83¾	$0.85
February	36	37¾	32½	35	29½	31	27¾	29	28	30	26	27⅜	.81¼	.85
March	37	40	33¼	36½	29½	31	25⅛	29¼	29	30½	26	27¼	.82½	.83¾
April	35⅜	41	34½	36	31	32¼	28¾	30⅞	28½	32	25¾	27¾	.85	.91¼
May	33½	35¾	33	36	30	32½	27½	29½	28	28½	25¼	27¼	.85	.90
June	33	34¼	23	36½	29	30	26¼	28½	27	29	24⅝	26⅛	.82½	.83¾
July	30⅝	34	30	35	27½	30½	24¼	27¾	25	29	22	25½	.80	.80
August	26¼	31¼	26¼	31	24	27½	20½	25	22½	26½	18½	22¾	.77½	.81¼
September	25¼	27⅝	26	30	22⅛	26	19⅛	22¼	20½	24½	17¾	21	.75	.77½
October	28	34¼	27	35½	26	30	22¼	26½	24½	30	21	24¼	.78¾	.87½
November	28⅜	31¾	23½	30½	22	27	22¾	25½	22	25	21¼	23½	.87½	.90
December	28⅛	29¾	22	30	22	24	22½	28¾	20½	22	19⅞	21½	.85	.87½
1897.														
January	28¼	29¾	22	28¼	22½	24	21¾	23⅜	21½	23	19¼	20¾	.77½	.87½
February	28	29⅞	26	29	23½	25	21¾	23¼	21½	23½	19½	20½	.77½	.82½
March	27	30½	26½	31	24	25½	22¾	24½	23	25	20⅛	21½	.80	.85
April	28¾	30⅞	28½	31	25	30	23⅛	25¼	24	26	20½	22¾	.81¼	.85
May	29	30⅞	31	34	26½	31	23	25½	23	27	20⅝	24	.82½	.97½
June	28½	30	30	33	26	27½	23¼	25⅝	24	27	21½	23½	.90	.97½
July	28½	33⅞	30	35	27½	29½	24⅝	28¼	26½	28½	21½	25½	.90	.97½
August	31¼	38	34	38	28¾	33	26⅛	32⅝	28½	32½	25	27¾	1.05	1.10
September	32	37½	36	39	30½	33⅛	27¼	32	30	32½	25	29½	1.07½	1.12½
October	29⅜	33½	31	37½	26½	31	24	29	24½	31	24	27½	1.10	1.12½
November	30⅝	32¾	30	35½	26	28½	25¾	27⅞	25⅞	26½	21⅜	26⅛	.90	.97½
December	31¼	31	27½	35½	27	30	25	27½	26½	30½	24	26¼	.90	.92½
1898.														
January	33	35½	29	35¾	29	30	26	28¼	28½	30	25¼	26¾	.85	.97½
February	34¼	37¼	32	36	29½	32	27¼	30⅝	28¾	33½	26	28½	.97½	1.10
March	34¼	36¼	32½	35	31⅝	32¼	28⅛	29¾	29½	32	26½	27⅞	1.05	1.12½
April	34⅞	40⅝	34	42	31½	38	28⅞	35¼	31	36½	27	32¾	1.10	1.15
May	36¾	41⅞	36¾	42⅛	37	40	32⅛	37	35	39½	32	35½	1.10	1.12½
June	35⅛	38⅝	35½	37½	34¼	36	31	33¾	31¾	36	30	32½	1.05	1.12½
July	35½	38¾	35	42	34½	37½	31¾	35½	32	36	30½	33¾	1.07½	1.12½
August	35	38	33	41	31	36½	29¾	33¾	32	35½	28¼	33	1.10	1.17½
September	34	35½	31	36½	31	31½	29⅛	31⅜	30½	32½	28½	29⅝	1.12½	1.15
October	34¼	38¾	34	38	31	35	28¾	32⅞	30	35½	29	32½	1.05	1.15
November	37½	39¼	32	39	34	37	31⅝	34½	34	36	30	32¼	1.05	1.07½
December	38⅞	44¼	36	43½	34	38½	33½	38	34	.38	31¾	36½	1.05	1.15

Wholesale prices of corn per bushel in leading cities of the United States, 1896–1901—Continued.

Date.	New York.		Baltimore.		Cincinnati.		Chicago.		Detroit.		St. Louis.		San Francisco.	
	No. 2.		No. 2.		No. 2.		No. 2.		No. 2.		No. 2.		No. 1, white (per cwt.).	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1899.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*		
January	41⅜	45⅝	39½	41⅝	35½	38	35¼	38⅛	37	38	34¾	36¼	$1.12	$1.15
February	42¼	45	37¾	42	33	37	33½	37	35½	37	33	35	Nominal.	
March	41	45⅛	36	39⅜	35	37½	33	36⅛	34¼	36½	33	34¾	Nominal.	
April	41	45½	38	43	36½	37½	34	35⅛	35½	37½	33½	35	1.15	1.17½
May	39¼	43½	36⅞	38¾	34	36½	32½	34⅜	34⅛	35½	31½	34½	1.17½	1.17½
June	40½	42⅝	37	39⅛	35	36⅜	33¼	35½	34½	35	32	33½	1.15	1.17½
July	37⅞	41⅛	35	38¾	35	36½	31	34⅞	34	35⅛	31⅛	33½	1.15	1.15
August	36½	41¼	34¾	37½	32	34½	30½	33	33⅛	35	30	31½	1.07½	1.12½
September	38⅝	41⅝	36⅛	40½	33¾	35	31¼	35	33¼	35⅛	30	31	1.07½	1.07½
October	39¾	42⅜	37½	39¼	34	36	31	33	34½	36½	30½	31¾	Nominal.	
November	39⅝	41¼	37⅛	39¾	31⅛	35	30¾	33¼	33	35¼	30	31½	Nominal.	
December	39⅞	40⅞	36⅜	38⅜	31⅛	34	30	31½	32	33½	29½	31	1.05	1.05
1900.			Mixed.											
January	39⅞	42¼	36⅜	37¾	32¾	36	30½	31⅝	32½	34	30½	31	1.00	1.00
February	39⅞	44⅛	36¾	40⅜	33¼	36	31½	34¼	33½	35½	30½	33½	1.00	1.00
March	40⅞	46	38	42⅞	36	40¾	33⅜	38¼	36	40½	33½	37½	1.02½	1.10
April	45¾	49¾	42⅝	45½	41	43½	38¼	40⅞	40	40½	37½	39¾	1.07½	1.10
May	41	47⅛	40⅝	45	40½	44	36	40½	39¼	41	36⅜	40½	1.02½	1.07½
June	42¾	50⅝	41⅝	48	39¾	45	37⅜	43½	39¾	45	37	42	1.02½	1.17½
July	44	52⅛	42⅜	48¾	41½	47	38⅜	44¾	40¾	45	37½	43	1.17½	1.17½
August	42⅞	47¾	41¾	45	41	43	37¼	41¼	42½	43¾	37½	40	1.22½	1.30
September	45	50⅜	44¼	47	42½	44	38⅞	43¼	43½	44	38¾	40½	Nominal.	
October	46	49¾	42	47	37	43	36½	41¾	41	43½	34	39	1.25	1.27½
November	45¾	47½	42¼	44½	37	40	35	49½	38¾	41	34¼	35¾	1.20	1.25
December	44¾	48	41⅞	44¼	37¾	39½	35¼	40½	38	39½	33¾	36	1.20	1.20
1901.														
January	45½	48⅛	41½	43¼	38	40	36	37¾	38	39½	35	37	1.12½	1.15
February	47½	49	42¼	45	39½	42¼	37¼	40	39¼	40½	37½	40	1.10	1.20
March	48¼	50½	44¼	48¼	41½	42¾	39	44	40	43	38¾	43	1.15	1.32½
April	48½	53¾	46⅛	49¾	44½	47	41	48	43	45½	41	46¼	1.15	1.35
May	49	56	46¾	50¼	43¼	46½	42⅝	58⅛	42¼	46	42	45⅝	1.20	1.35
June	46¼	49¾	44⅛	47¾	43⅛	44½	41	44⅞	42	45	41¼	44	1.25	1.37½
July	50⅛	61¼	46¼	59	45	58	43½	58¼	44½	56½	43¾	60½	1.50	[illegible]
August	60	64	56⅛	63½	57½	64	53¾	59½	37	39½	55¼	63	1.65	
September	61½	66⅛	59¼	62	56½	61½	54⅛	59¾	55¾	59½	55¾	60	1.55	
October	60⅞	64	58¼	61	60	60½	54⅝	58	57½	60	57	61	[illegible]	
November	63¼	69⅛	60¾	67	63	66	57⅛	63⅞	60	66½	60⅛	66[illegible]		
December	69¼	72⅞	65	68	66¼	71½	62½	67⅛	66½	70½	65½	[illegible]		

Monthly average prices of corn in Chicago. [a]

[Cents per bushel.]

Month.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
January	$29\frac{1}{16}$	$48\frac{3}{4}$	$38\frac{3}{16}$	$42\frac{5}{8}$	$34\frac{7}{8}$	43	$26\frac{7}{8}$	$22\frac{9}{16}$	$27\frac{1}{8}$	$36\frac{11}{16}$	$31\frac{1}{16}$	$36\frac{7}{8}$
February	$28\frac{1}{4}$	$52\frac{3}{8}$	$40\frac{1}{8}$	42	$34\frac{11}{16}$	$42\frac{1}{8}$	$28\frac{7}{16}$	$22\frac{1}{8}$	$28\frac{7}{16}$	$35\frac{1}{4}$	$32\frac{7}{8}$	$38\frac{5}{8}$
March	$28\frac{11}{16}$	62	$39\frac{1}{16}$	$40\frac{13}{16}$	$35\frac{3}{4}$	$44\frac{3}{8}$	$28\frac{5}{8}$	$23\frac{3}{4}$	$28\frac{15}{16}$	$34\frac{9}{16}$	$35\frac{13}{16}$	$41\frac{1}{2}$
April	$31\frac{5}{16}$	$70\frac{11}{16}$	$40\frac{5}{8}$	$40\frac{3}{4}$	$37\frac{7}{8}$	$46\frac{15}{16}$	$29\frac{5}{8}$	$24\frac{3}{16}$	$32\frac{1}{16}$	$34\frac{3}{4}$	$39\frac{9}{16}$	$44\frac{1}{2}$
May	$33\frac{7}{8}$	$62\frac{1}{4}$	$70\frac{3}{8}$	42	$37\frac{5}{8}$	$51\frac{5}{8}$	$28\frac{1}{2}$	$24\frac{1}{4}$	$39\frac{11}{16}$	$33\frac{7}{16}$	$38\frac{1}{4}$	$50\frac{9}{16}$
June	$33\frac{15}{16}$	$58\frac{1}{8}$	51	$39\frac{9}{16}$	$39\frac{15}{16}$	50	$27\frac{3}{8}$	$24\frac{7}{16}$	$32\frac{3}{8}$	$34\frac{3}{8}$	$40\frac{7}{16}$	$42\frac{11}{16}$
July	$40\frac{1}{4}$	$61\frac{1}{2}$	$49\frac{5}{8}$	$38\frac{11}{16}$	$43\frac{1}{2}$	$44\frac{5}{8}$	26	$26\frac{7}{16}$	$38\frac{5}{8}$	$32\frac{15}{16}$	$41\frac{9}{16}$	$50\frac{7}{8}$
August	48	$63\frac{3}{16}$	$51\frac{13}{16}$	$38\frac{3}{16}$	$53\frac{1}{16}$	$40\frac{3}{8}$	$22\frac{3}{4}$	$29\frac{3}{8}$	$31\frac{3}{4}$	$31\frac{3}{4}$	$39\frac{1}{4}$	$56\frac{5}{8}$
September	$47\frac{1}{2}$	$58\frac{3}{4}$	$46\frac{3}{16}$	$39\frac{7}{8}$	53	$33\frac{15}{16}$	$20\frac{7}{8}$	$29\frac{5}{8}$	$30\frac{1}{4}$	$33\frac{1}{8}$	$41\frac{1}{16}$	$56\frac{15}{16}$
October	$50\frac{3}{4}$	$55\frac{1}{4}$	$42\frac{3}{8}$	39	$50\frac{11}{16}$	$30\frac{3}{8}$	$24\frac{3}{8}$	$26\frac{1}{2}$	$30\frac{13}{16}$	32	$39\frac{1}{8}$	$56\frac{5}{16}$
November	$51\frac{7}{16}$	$63\frac{1}{2}$	$41\frac{13}{16}$	$37\frac{3}{16}$	50	$28\frac{1}{4}$	$24\frac{1}{8}$	$26\frac{11}{16}$	$33\frac{1}{16}$	32	$42\frac{1}{4}$	$60\frac{3}{4}$
December	$50\frac{3}{8}$	$49\frac{3}{16}$	$41\frac{7}{16}$	$35\frac{3}{8}$	$46\frac{1}{8}$	$25\frac{7}{8}$	$23\frac{1}{8}$	$26\frac{1}{4}$	$35\frac{9}{16}$	$30\frac{3}{4}$	$37\frac{7}{8}$	65
Yearly average	$39\frac{7}{16}$	$58\frac{3}{4}$	$46\frac{1}{16}$	$39\frac{5}{8}$	$43\frac{1}{16}$	$40\frac{1}{8}$	$25\frac{7}{8}$	$25\frac{1}{2}$	$32\frac{3}{8}$	$33\frac{7}{16}$	$38\frac{1}{4}$	$50\frac{1}{8}$

[a] This table exhibits average cash prices for the past twelve years. The monthly prices are the means between the lowest and highest prices for each month, and the yearly prices are the averages of the monthly averages.

WHEAT.

The wholesale prices of wheat held steadier and less spasmodic during the year 1901 than usual, and the year's fluctuations did not extend through so wide a range. The low price for cash wheat in Chicago was $63\frac{1}{8}$ cents, and the high price was $79\frac{1}{2}$ cents, or a range of $16\frac{3}{8}$ cents. The year's range for 1900 covered $26\frac{1}{2}$ cents, most of this wide range occurring in the one month—June. In the year just closed the greatest fluctuation again happened to be in June. The prices for the last three years ruled generally higher than for the several years previous to the wide fluctuations in 1897 and 1898.

Wheat crop of the world, 1897–1901.

Country.	1897.	1898.	1899.	1900.	1901.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States	530,149,000	675,149,000	547,304,000	522,230,000	748,460,000
Ontario	29,765,000	33,042,000	22,158,000	31,265,000	22,194,000
Manitoba	18,837,000	26,112,000	28,802,000	13,436,000	52,094,000
Rest of Canada	7,500,000	9,000,000	9,000,000	7,000,000	16,000,000
Total Canada	56,102,000	68,154,000	59,960,000	51,701,000	90,288,000
Mexico	9,700,000	8,789,000	9,287,000	15,000,000	9,000,000
Total North America	595,951,000	752,092,000	616,551,000	588,931,000	847,748,000
Chile	10,500,000	14,000,000	13,000,000	12,000,000	9,000,000
Argentina	31,600,000	53,389,000	104,977,000	101,655,000	74,753,000
Uruguay	3,600,000	6,000,000	7,164,000	6,891,000	3,664,000
Total South America	45,700,000	73,389,000	125,141,000	120,546,000	87,417,000
Great Britain	56,672,000	75,330,000	67,594,000	54,299,000	54,111,000
Ireland	1,355,000	1,856,000	1,786,000	1,682,000	1,470,000
Total United Kingdom	58,027,000	77,186,000	69,380,000	55,981,000	55,581,000
Norway	300,000	300,000	260,000	300,000	300,000
Sweden	4,678,000	4,542,000	4,430,000	5,249,000	4,310,000
Denmark	3,474,000	2,991,000	3,654,000	3,604,000	3,000,000
Netherlands	4,290,000	5,406,000	5,096,000	5,000,000	4,300,000
Belgium	11,592,000	13,211,000	11,319,000	13,788,000	12,920,000
France	246,596,000	363,498,000	364,414,000	326,083,000	304,210,000
Spain	93,194,000	123,865,000	100,759,000	92,424,000	108,000,000
Portugal	8,200,000	7,800,000	6,400,000	8,000,000	8,000,000
Italy	86,919,000	137,345,000	137,912,000	127,696,000	147,560,000
Switzerland	4,300,000	4,560,000	4,200,000	4,200,000	4,400,000
Germany	119,903,000	132,557,000	141,369,000	141,139,000	91,817,000

Wheat crop of the world, 1897–1901—Continued.

Country.	1897.	1898.	1899.	1900.	1901.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Austria	34,497,000	46,890,000	50,209,000	40,929,000	44,027,000
Hungary	81,075,000	128,227,000	141,285,000	141,221,000	127,864,000
Croatia-Slavonia	6,140,000	11,408,000	9,014,000	11,035,000	10,325,000
Bosnia-Herzegovina	1,484,000	2,297,000	2,000,000	1,750,000	2,000,000
Total Austria-Hungary	123,196,000	188,822,000	202,508,000	194,935,000	184,216,000
Roumania	36,448,000	58,457,000	26,064,000	56,663,000	72,386,000
Bulgaria	30,739,000	33,993.000	21,630,000	27,000,000	21,000,000
Servia	13,392,000	11,000,000	10,000,000	9,000,000	10,000,000
Montenegro	200,000	220,000	200,000	220,000	200,000
Turkey in Europe	17,800,000	25,000,000	15,000,000	20,000,000	22,000,000
Greece	3,200,000	4,000,000	2,500,000	3,000,000	3,000,000
Russia proper	238,557,000	334,246,000	314,876,000	319,193,000	319,991,000
Poland	17,808,000	21,691,000	21,544,000	19,722,000	14,409,000
North Caucasus	29,883,000	52,251,000	57,313,000	56,948,000	67,232,000
Finland	90,000	100,000	90,000	90,000	90,000
Total Russia in Europe	286,338,000	408,288,000	393,823,000	395,953,000	401,722,000
Total Europe	1,152,786,000	1,602,981,000	1,520,918,000	1,490,235,000	1,461,922,000
Siberia	42,835,000	36,157,000	45,473,000	20,172,000	16,504,000
Central Asia	11,087,000	14,944,000	14,938,000	6,959,000	9,645,000
Transcaucasia	40,000,000	40,000,000	33,000,000	35,000,000	35,000,000
Total Russia in Asia	93,922,000	91,101,000	93,411,000	62,131,000	61,149,000
Turkey in Asia	48,000,000	44,000,000	35,200,000	30,000,000	30,000,000
Cyprus	2,400,000	2,400,000	2,000,000	2,400,000	2,000,000
Persia	20,000,000	17,600,000	16,000,000	16,000,000	15,200,000
British India	191,257,000	259,670,000	236,679,000	181,803,000	245,751,000
Japan	19,509,000	21,407,000	20,771,000	21,688,000	20,000,000
Total Asia	375,088,000	436,178,000	401,061,000	314,022,000	374,100,000
Algeria	19,891,000	27,114,000	22,282,000	23,000,000	25,000,000
Tunis	5,000,000	6,500,000	4,800,000	5,600,000	6,400,000
Egypt	12,000,000	13,000,000	13,000,000	13,000,000	12,000,000
Cape Colony	2,200,000	2,012,000	2,291,000	2,000,000	2,000,000
Total Africa	39,091,000	48,626,000	42,373,000	43,600,000	45,400,000
West Australia	252,000	421,000	892,000	1,018,000	799,000
South Australia	2,893,000	4,141,000	9,056,000	8,720,000	11,608,000
Queensland	620,000	1,041,000	626,000	634,000	1,232,000
New South Wales	9,132,000	10,893,000	9,569,000	14,033,000	16,683,000
Victoria	7,315,000	10,914,000	20,198,000	15,718,000	18,410,000
Tasmania	1,327,000	1,721,000	2,376,000	1,136,000	1,145,000
New Zealand	6,113,000	5,849,000	13,485,000	8,852,000	6,733,000
Total Australasia	27,652,000	31,980,000	56,202,000	50,111,000	56,610,000

RECAPITULATION BY CONTINENTS.

	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
North America	595,951,000	752,092,000	616,551,000	588,931,000	847,748,000
South America	45,700,000	73,389,000	125,141,000	120,546,000	87,417,000
Europe	1,152,786,000	1,602,981,000	1,520,918,000	1,490,235,000	1,461,922,000
Asia	375,088,000	436,178,000	404,061,000	314,022,000	374,100,000
Africa	39,091,000	48,626,000	42,373,000	43,000,000	45,400,000
Australasia	27,652,000	34,980,000	56,202,000	50,111,000	56,610,000
Total	2,236,268,000	2,948,246,000	2,765,246,000	2,607,445,000	2,873,197,000

World's visible supply of wheat the first of each month for ten years.

Month.	1892-1893.	1893-1894.	1894-1895.	1895-1896.	1896-1897.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	132,100,000	183,700,000	172,600,000	160,300,000	137,400,000
August	122,900,000	178,200,000	174,500,000	158,000,000	124,200,000
September	145,700,000	182,900,000	189,500,000	152,200,000	126,400.000
October	166,300,000	195,700,000	205,200,000	176,500,000	151,200,000
November	196,200,000	220,600,000	220,800,000	209,800,000	190,300,000
December	231,500,000	237,500,000	218,800,000	218,700,000	202,300,000
January	237,400,000	232,000,000	227,800,000	224,700,000	184,600,000
February	234,200,000	232,900,000	223,000,000	202,800,000	173,400,000
March	229,300,000	222,400,000	212,400,000	191,900,000	155,500,000
April	221,600,000	216,500,000	198,200,000	180,600,000	139,000,000
May	215,500,000	206,900,000	186,500,000	161,100,000	121,400,000
June	205,000,000	195,700,000	171,100,000	147,500,000	106,900,000

Month.	1897-1898.	1898-1899.	1899-1900.	1900-1901.	1901-1902.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	88,700,000	86,700,000	140,200,000	149,800,000	136,000,000
August	77,500,000	70,100,000	134,500,000	150,100,000	132,400,000
September	87,000,000	66,500,000	142,500,000	164,600,000	141,100,000
October	119,100,000	83,000,000	162,800,000	188,200,000	159,500,000
November	139,300,000	106,800,000	191,100,000	200,800,000	169,900,000
December	156,000,000	135,800,000	203,400,000	208,200,000	202,100,000
January	157,000,000	147,100,000	202,700,000	200,500,000	201,000,000
February	151,700,000	146,400,000	190,500,000	197,900,000	202,300,000
March	140,500,000	151,100,000	181,500,000	192,700,000	191,900,000
April	132,000,000	144,900,000	184,100,000	187,800,000	....
May	111,200,000	139,500,000	175,700,000	171,800,000	....
June	109,800,000	136,900,000	157,400,000	152,500,000	....

Statement showing world's export shipments of wheat and flour for five years.

	1897.	1898.	1899.	1900.	1901.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
America	182,829,000	230,390,000	207,490,000	189,820,000	....
Russia	118,546,000	102,864,000	61,141,000	67,460,000	87,417,000
Danubian	15,632,000	14,952,000	14,410,000	36,824,000	1,461,922,000
Argentina	1,808,000	22,984,000	61,720,000	72,002,000	374,100,000
India	1,688,000	33,488,000	23,160,000	12,000	45,400,000
Australia	....	142,000	10,155,000	7,188,000	56,610,000
Total	320,553,000	404,820,000	378,076,000	373,306,000	....

Visible supply of wheat in the United States and Canada, first of each month for ten years.

EAST OF ROCKY MOUNTAINS.[a]

Month.	1892-1893.	1893-1894.	1894-1895.	1895-1896.	1896-1897.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	33,287,000	75,366,000	65,250,000	53,568,000	61,354,000
August	31,310,000	69,889,000	69,766,000	46,767,000	58,414,000
September	42,875,000	64,823,000	79,826,000	44,732,000	57,588,000
October	59,845,000	71,108,000	92,100,000	55,078,000	63,955,000
November	78,625,000	83,265,000	108,072,000	75,598,000	76,716,000
December	94,671,000	96,597.000	113,116,000	87,688,000	76,433,000
January	107,057,000	99,542,000	113,707,000	97,769,000	73,270,000
February	111,905,000	98,836,000	106,917,000	97,592,000	68,092,000
March	109,370,000	93,926,000	98,745,000	94,538,000	61,624,000
April	108,391,000	89,362,000	91,286,000	90,442,000	55,946,000
May	101,360,000	82,085,000	80,454,000	80,390,000	49,684,000
June	90,681,000	71,816,000	64,375,000	68,773,000	37,975,000

[a] The figures for stocks east of the Rocky Mountains represent 62 principal points of accumulation, including the Manitoba elevators and stocks afloat on lakes and canals.

Visible supply of wheat in the United States and Canada, first of each month for ten years—Continued.

EAST OF ROCKY MOUNTAINS—Continued.

Month.	1897-1898.	1898-1899.	1899-1900.	1900-1901.	1901-1902.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	27,090,000	18,069,000	46,870,000	58,523,000	39,817,000
August	23,793,000	12,325,000	48,622,000	60,398,000	40,924,000
September	20,073,000	11,499,000	48,087,000	66,240,000	39,348,000
October	31,508,000	22,857,000	60,040,000	76,071,000	51,442,000
November	42,609,000	31,864,000	77,195,000	82,238,000	64,616,000
December	50,059,000	45,914,000	84,687,000	86,591,000	85,631,000
January	54,178,000	50,126,000	89,265,000	87,911,000	94,900,000
February	51,105,000	51,648,000	87,473,000	86,324,000	88,800,000
March	46,532,000	51,085,000	85,570,000	80,704,000	84,315,000
April	40,901,000	51,238,000	79,690,000	75,501,000	75,598,000
May	31,039,000	47,258,000	70,764,000	60,298,000	54,610,000
June	29,226,000	42,092,000	57,617,000	47,109,000	....

PACIFIC COAST.

Month.	1892-1893.	1893-1894.	1894-1895.	1895-1896.	1896-1897.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	2,372,000	2,842,000	8,253,000	6,549,000	1,927,000
August	2,770,000	4,487,000	8,321,000	4,762,000	1,917,000
September	3,589,000	6,114,000	8,532,000	8,799,000	3,512,000
October	8,153,000	7,162,000	9,074,000	9,760,000	5,454,000
November	8,714,000	7,760,000	13,130,000	9,651,000	6,883,000
December	10,415,000	10,629,000	14,582,000	8,276,000	6,548,000
January	9,305,000	10,721,000	13,302,000	7,116,000	4,189,000
February	6,457,000	9,859,000	13,118,000	5,859,000	3,005,000
March	5,300,000	9,622,000	11,801,000	4,296,000	1,857,000
April	4,788,000	9,005,000	10,456,000	3,822,000	1,730,000
May	3,546,000	9,378,000	10,150,000	3,182,000	1,614,000
June	3,019,000	8,704,000	8,445,000	2,556,000	1,221,000

Month.	1897-1898.	1898-1899.	1899-1900.	1900-1901.	1901-1902.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	1,112,000	2,935,000	3,409,000	5,903,000	3,228,000
August	2,247,000	2,608,000	4,188,000	5,770,000	3,985,000
September	4,651,000	3,005,000	6,282,000	7,483,000	4,266,000
October	6,251,000	4,671,000	8,858,000	10,208,000	6,325,000
November	7,391,000	5,621,000	11,085,000	9,983,000	7,262,000
December	6,944,000	6,296,000	10,678,000	10,057,000	7,378,000
January	6,661,000	5,923,000	10,022,000	8,686,000	7,186,000
February	5,318,000	5,039,000	8,923,000	8,717,000	6,521,000
March	4,424,000	5,104,000	7,814,000	6,972,000	5,542,000
April	3,466,000	4,321,000	7,207,000	6,325,000	5,428,000
May	3,051,000	4,455,000	7,050,000	5,071,000	3,685,000
June	3,236,000	3,635,000	6,866,000	4,672,000	....

Statement showing the amount of wheat in farmers' hands, visible supply of the United States and the world, and price, on March 1, 1891-1902.

Year.	Stocks in farmers' hands in United States.	Visible supply of the United States.	Visible supply of the world.	Price at Chicago.
	Bushels.	*Bushels.*	*Bushels.*	*Cts. per bu.*
1891	112,000,000	42,401,815	....	94¼
1892	171,070,881	64,377,444	181,400,000	87⅜
1893	135,205,430	109,370,000	229,300,000	72⅜
1894	114,060,440	93,926,000	222,400,000	58⅜
1895	74,999,790	98,745,000	212,400,000	52½
1896	123,645,290	94,538,000	191,900,000	66⅜
1897	88,149,072	61,624,000	155,500,000	74⅜
1898	121,320,500	46,532,000	140,500,000	104⅜
1899	198,056,496	51,085,000	151,100,000	72⅞
1900	158,700,000	85,570,000	181,500,000	64⅜
1901	128,100,000	80,704,000	192,700,000	74
1902	....	84,315,000	191,900,000	76

Condition of wheat crop in the United States, monthly, 1886–1901.

Year.	Winter wheat.					Spring wheat.			
	April.	May.	June.	July.	When harvested.	June.	July.	August.	When harvested.
1886	94.1	94.9	92.7	91.2	90.8	98.5	83.3	80.1	83.5
1887	88.1	85.8	84.9	83.5	84.0	87.3	79.3	78.8	78.1
1888	82.0	73.1	73.3	75.6	77.4	92.8	95.9	87.3	77.2
1889	94.0	96.0	93.1	92.0	89.4	94.4	83.3	81.2	83.8
1890	81.0	80.0	78.1	76.2	73.5	91.3	94.4	83.2	79.8
1891	96.9	97.9	96.6	96.2	96.7	92.6	94.1	95.5	97.2
1892	81.2	84.0	88.3	89.6	87.6	92.3	90.9	87.3	81.2
1893	77.4	75.3	75.5	77.7	[a] 74.0	86.4	74.1	67.0	....
1894	86.7	81.4	83.2	83.9	[a] 83.7	88.0	68.4	67.1	....
1895	81.4	82.9	71.1	65.8	[a] 75.4	97.8	102.2	95.9	....
1896	77.1	82.7	77.9	75.6	[a] 74.6	99.9	93.3	78.9	....
1897	81.4	80.2	78.5	81.2	[a] 85.7	89.6	91.2	86.7	....
1898	86.7	86.5	90.8	85.7	[a] 86.7	100.9	95.0	96.5	....
1899	77.9	76.2	67.3	65.6	[a] 70.9	91.4	91.7	83.6	....
1900	82.1	88.9	82.7	80.8	[a] 69.6	87.3	55.2	56.4	....
1901	91.7	94.1	87.8	88.3	[a] 82.8	92.0	95.6	80.3	....

[a] Includes both winter and spring.

Acreage, production, value, prices, and exports of wheat of the United States, 1866–1901.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1.	Farm value, Dec. 1.	Chicago cash price per bushel.				Domestic exports, including flour, fiscal years beginning July 1.
						December.		May of following year.		
						Low.	High.	Low.	High.	
	Acres.	*Bush.*	*Bushels.*	*Cents.*	*Dollars.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Bushels.*
1866	15,424,496	9.9	151,999,906	152.7	232,109,630	129	145	185	211	12,646,941
1867	18,321,561	11.6	212,441,400	145.2	308,387,146	126	140	134	161	25,284,803
1868	18,460,132	12.1	224,036,600	108.5	243,032,746	80	88	87	96	29,717,201
1869	19,181,004	13.6	260,146,900	76.5	199,024,996	63	76	79	92	53,900,780
1870	18,992,591	12.4	235,884,700	94.4	222,766,969	91	98	113	120	52,580,111
1871	19,943,893	11.6	230,722,400	114.5	264,075,851	107	111	120	143	38,995,755
1872	20,858,359	11.9	249,997,100	111.4	278,522,068	97	108	112	122	52,014,715
1873	22,171,676	12.7	281,254,700	106.9	300,669,533	96	106	105	114	91,510,398
1874	24,967,027	12.3	308,102,700	86.3	265,881,167	78	83	78	94	72,912,817
1875	26,381,512	11.1	292,136,000	89.5	261,396,926	82	91	89	100	74,750,682
1876	27,627,021	10.5	289,356,500	96.3	278,697,238	104	117	130	172	57,043,936
1877	26,277,546	13.9	364,194,146	105.7	385,089,444	103	108	98	113	92,071,726
1878	32,108,560	13.1	420,122,400	77.6	325,814,119	81	84	91	102	150,502,506
1879	32,545,950	13.8	448,756,630	110.8	497,030,142	122	133⅜	112⅛	119	180,304,180
1880	37,986,717	13.1	498,549,868	95.1	474,201,850	93⅛	109¾	101	112⅜	186,321,514
1881	37,709,020	10.2	383,280,090	119.2	456,880,427	124¾	129	128	140	121,892,389
1882	37,067,194	13.6	504,185,470	88.4	445,602,125	91⅛	94⅞	108	113⅜	147,811,316
1883	36,455,593	11.6	421,086,160	91.1	383,649,272	94⅜	99¼	85	94¾	111,534,182
1884	39,475,885	13.0	512,765,000	64.5	330,862,260	69⅛	76⅝	85⅜	90¾	132,570,366
1885	34,189,246	10.4	357,112,000	77.1	275,320,390	82⅞	89	72⅛	79	94,565,793
1886	36,806,184	12.4	457,218,000	68.7	314,226,020	75⅛	79⅛	80¾	88¾	153,804,969
1887	37,641,783	12.1	456,329,000	68.1	310,612,960	75⅛	79¼	81⅛	89⅞	119,625,344
1888	37,336,138	11.1	415,868,000	92.6	385,248,030	96⅜	105⅛	77½	95⅛	88,600,742
1889	38,123,859	12.9	490,560,000	69.8	342,491,707	76¾	80⅛	89¾	100	109,430,467
1890	36,087,154	11.1	399,262,000	83.8	334,773,678	87⅛	92¾	98⅞	108	106,181,316
1891	39,916,897	15.3	611,780,000	83.9	513,472,711	89⅜	93¼	80	85¾	225,665,812
1892	38,554,430	13.4	515,949,000	62.4	322,111,881	69⅛	73	68¼	76¼	191,912,635
1893	34,629,418	11.4	396,131,725	53.8	213,171,381	59⅛	64⅛	52⅛	60⅛	164,283,129
1894	34,882,436	13.2	460,267,416	49.1	225,902,025	52¾	63⅝	60¾	85⅝	144,812,718
1895	34,047,332	13.7	467,102,947	50.9	237,938,998	53¾	64¾	57⅛	67⅝	126,443,968
1896	34,618,646	12.4	427,684,346	72.6	310,602,539	74⅜	93⅛	68¾	97⅞	145,124,972
1897	39,465,066	13.4	530,149,168	80.8	428,547,121	92	109	117	185	217,306,005
1898	44,055,278	15.3	675,148,705	58.2	392,770,320	62¾	70	68⅜	79⅛	222,618,420
1899	44,592,516	12.3	547,303,846	58.4	319,545,259	64	69⅛	63⅜	67⅛	186,096,762
1900	42,495,385	12.3	522,229,505	61.9	323,515,177	69¼	75⅜	70	75⅛	215,990,073
1901	49,895,514	15.0	748,460,218	62.4	467,350,156	73	79⅜	......	......	....

Acreage, production, value, and distribution of wheat of the United States in 1901, by States.

States and Territories.	Crop of 1901.			Stock on hand Mar. 1, 1902.		Shipped out of county where grown.
	Acreage.	Production.	Value.			
	Acres.	*Bushels.*	*Dollars.*	*Bushels.*	*Per cent.*	*Bushels.*
Maine	7,419	177,314	171,995	63,833	36	....
Vermont	1,712	32,575	30,620	17,265	53	32[illegible]
New York	597,823	7,831,481	6,421,814	1,566,296	20	1,331,352
New Jersey	122,741	2,062,049	1,484,675	556,753	27	494,892
Pennsylvania	1,676,070	28,660,797	20,635,774	10,327,887	36	6,878,591
Delaware	113,329	2,096,586	1,458,576	461,219	22	1,069,259
Maryland	774,136	13,315,139	9,453,749	2,663,028	20	7,456,478
Virginia	888,091	9,680,192	7,066,540	3,000,860	31	3,484,869
North Carolina	777,255	6,762,118	5,544,937	2,096,257	31	405,727
South Carolina	259,160	2,280,608	2,234,996	433,316	19	45,612
Georgia	370,996	3,042,167	2,859,637	608,433	20	121,687
Alabama	132,788	1,155,256	1,016,625	138,631	12	23,105
Mississippi	4,389	38,623	33,216	6,180	16	....
Texas	681,126	6,062,021	4,728,376	606,202	10	363,721
Arkansas	355,325	3,126,860	2,438,951	562,835	18	62,537
Tennessee	1,212,441	13,094,363	9,689,829	2,880,760	22	3,928,809
West Virginia	416,004	4,534,444	3,491,522	1,314,989	29	453,444
Kentucky	959,603	11,611,196	8,360,061	2,206,127	19	4,063,919
Ohio	2,191,670	33,532,551	23,808,111	10,395,091	31	13,413,020
Michigan	1,234,499	13,702,939	9,729,087	3,425,735	25	5,755,234
Indiana	2,021,069	31,932,890	22,353,023	7,663,894	24	15,327,787
Illinois	1,707,503	30,052,053	20,735,917	5,709,890	19	3,005,205
Wisconsin	469,920	7,576,874	4,924,968	2,651,906	35	1,363,837
Minnesota	6,209,506	80,102,627	48,061,576	21,627,709	27	33,643,103
Iowa	1,295,689	21,048,101	12,628,861	5,893,468	28	6,314,430
Missouri	1,958,308	31,137,097	21,484,597	7,161,532	23	4,670,565
Kansas	5,355,638	99,079,304	58,456,789	23,779,033	24	67,373,927
Nebraska	2,456,543	42,006,885	22,683,718	12,181,997	29	21,843,580
South Dakota	4,001,830	51,662,307	27,381,023	12,398,954	24	38,230,107
North Dakota	4,527,532	59,310,669	32,027,761	10,082,814	17	48,041,642
Montana	88,807	2,353,386	1,576,769	800,151	34	564,818
Wyoming	21,027	515,162	355,462	113,336	22	....
Colorado	312,521	7,531,756	5,046,277	1,280,399	17	4,067,148
New Mexico	44,295	952,342	685,686	171,422	18	66,664
Arizona	26,047	507,825	482,651	85,174	15	73,817
Utah	180,433	3,698,876	2,589,218	1,072,674	29	818,753
Nevada	19,450	488,195	429,612	53,701	11	14,646
Idaho	294,397	6,241,216	3,807,142	811,358	13	3,619,905
Washington	1,185,793	34,518,968	16,213,915	5,177,845	15	28,995,933
Oregon	814,742	17,158,065	9,265,355	2,402,129	14	12,010,645
California	2,672,547	34,743,111	20,845,847	5,211,467	15	25,015,040
Oklahoma	1,253,583	20,558,761	12,952,019	3,700,577	18	8,017,917
Indian Territory	198,727	2,424,469	1,672,884	339,426	14	290,936
United States	49,895,514	748,460,218	467,350,156	173,702,583	23.2	372,717,482

HARVEST TIME FOR WHEAT.

The harvest of the wheat crop of the world is going on constantly.

It changes its location with the changing seasons. The following presents briefly its course of travel, with approximately the total amount of wheat, in bushels, produced by the countries named, based on returns for 1901:

May: Morocco, ————; Algiers, 25,000,000; Tunis, 6,400,000; Tripoli, ————; Central Asia, 9,645,000; China, ————; Japan, 20,000,000; Texas, 6,062,021.

June: California, 34,743,111; Spain, 108,000,000; Portugal, 8,000,000; Italy, 147,560,000; Greece, 3,000,000; Oregon, 17,158,065; Alabama, 1,155,256; Georgia, 3,042,167; Kansas, 99,079,304; Colorado, 7,531,756; Missouri, 31,137,097.

July: France, 304,210,000; Austria-Hungary, 184,216,000; Roumania, 72,386,000; Southern Russia, 401,722,000; Nebraska, 42,006,885; Minnesota, 80,102,627; New England, 209,889; Upper Canada, 22,194,000.

August: England and Ireland, 55,581,000; Belgium, 12,920,000; Germany, 91,817,000; Holland, 4,300,000; Denmark, 3,000,000; Poland, 14,409,000; Manitoba, 52,094,000; Lower Canada, 16,000,000; British Columbia, ————.

September: Scotland, ————; Sweden, 4,310,000; Norway, 300,000.

October: Northern Russia (the whole European Russian crop is given with southern Russia); Siberia, 16,504,000.

November: Peru, ————; southern Africa, 2,000,000.

December: Burmah, ————; New Zealand, 6,733,000; Chile, 9,000,000.

January: Australia, 56,610,000; Argentina, 74,753,000.

February: India, 245,751,000.

March: Upper Egypt (the whole Egyptian crop is given under lower Egypt).

April: Lower Egypt, 12,000,000; Mexico, 9,000,000; Turkey, 22,000,000; Persia, 15,200,000; Asia Minor, 30,000,000.

Average yield per acre of wheat in the United States, 1892–1901, by States.

States and Territories.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	16.7	16.0	21.1	19.2	22.0	16.5	19.5	22.5	19.5	23.9
New Hampshire	16.2	15.0	20.0	19.3	21.0	16.0	19.0	17.2	16.3	......
Vermont	17.3	16.8	22.7	29.0	24.5	17.0	22.5	22.0	23.5	18.7
Connecticut	16.7	18.3	......	......	......	20.0	20.0	18.3	20.8	......
New York	16.2	14.5	14.8	18.1	16.0	21.4	21.2	18.5	17.7	13.1
New Jersey	14.3	14.5	15.3	12.4	15.3	18.5	17.4	14.5	19.1	16.8
Pennsylvania	14.6	14.0	15.0	16.6	14.0	19.7	17.5	13.6	13.5	17.1
Delaware	13.0	14.7	13.0	11.6	18.0	21.5	13.3	12.8	20.3	18.5
Maryland	13.2	13.5	15.3	17.0	17.0	19.2	15.3	14.1	19.5	17.2
Virginia	9.5	11.2	9.5	9.3	9.3	12.0	14.1	8.4	11.9	10.9
North Carolina	7.1	8.2	5.0	6.9	7.3	8.0	9.2	6.7	9.6	8.7
South Carolina	6.5	6.3	5.6	6.4	6.8	8.7	10.6	6.5	9.0	8.8
Georgia	6.8	7.2	6.9	6.2	8.0	9.4	10.0	6.8	9.1	8.2
Alabama	6.7	8.2	8.3	7.5	8.0	10.0	12.0	7.6	9.5	8.7
Mississippi	6.8	7.5	9.8	8.0	8.5	10.0	13.9	7.7	9.6	8.8
Texas	12.3	10.5	15.1	5.7	11.7	15.8	14.8	11.1	18.4	8.9
Arkansas	8.2	8.0	8.8	9.4	8.0	10.5	11.0	8.6	10.1	8.8
Tennessee	9.5	9.2	8.1	8.8	8.5	11.2	13.2	8.7	9.9	10.8
West Virginia	10.7	11.5	12.1	10.6	10.3	13.4	13.8	9.3	9.8	10.9
Kentucky	11.8	11.3	12.5	10.9	8.7	13.6	15.4	9.1	13.0	12.1
Ohio	13.6	14.5	19.0	13.3	9.0	16.9	16.9	14.2	6.0	15.3
Michigan	14.7	13.2	15.8	13.2	12.8	15.6	20.8	8.4	7.6	11.1
Indiana	14.7	14.1	18.4	9.2	9.0	13.0	15.6	9.8	5.3	15.8
Illinois	16.2	11.5	18.2	11.0	14.7	7.9	11.0	10.0	13.0	17.6
Wisconsin	11.5	13.3	16.5	15.5	13.3	12.5	18.0	15.5	15.5	16.1
Minnesota	11.6	9.6	13.5	23.0	14.2	13.0	15.8	13.4	10.5	12.9
Iowa	11.5	11.5	14.8	19.5	16.0	13.0	16.7	13.0	15.6	16.2
Missouri	12.5	9.5	15.3	12.0	11.7	9.0	9.8	9.9	12.5	15.9
Kansas	17.4	8.4	10.4	7.7	10.6	15.5	14.2	9.8	17.7	18.5
Nebraska	12.5	8.7	7.0	12.0	14.0	14.5	16.4	10.3	12.0	17.1
South Dakota	12.5	8.5	6.6	12.0	11.2	8.0	12.4	10.7	6.9	12.9
North Dakota	12.2	9.6	11.8	21.0	11.8	10.3	14.4	12.8	4.9	13.1
Montana	21.5	21.5	24.8	23.9	26.5	32.5	29.5	25.7	26.6	26.5
Wyoming	17.5	18.7	19.6	26.0	24.5	25.0	23.7	18.8	17.6	24.5
Colorado	19.1	13.2	17.9	23.5	17.5	24.0	26.3	23.7	22.6	24.1
New Mexico	13.8	16.8	18.0	20.4	21.0	24.0	23.8	13.8	21.0	21.5
Arizona	15.6	17.5	17.0	20.5	23.0	18.0	31.7	15.3	14.6	21.8
Utah	17.3	13.8	22.0	22.4	26.5	21.0	28.0	20.7	20.9	20.5
Nevada	19.2	14.7	20.0	21.7	30.0	24.3	29.0	18.0	24.5	25.1
Idaho	22.0	19.3	20.6	17.8	24.5	22.0	31.0	24.2	20.8	21.2
Washington	17.2	20.3	16.6	15.5	18.0	23.5	24.2	22.7	23.5	29.1
Oregon	15.7	17.5	17.7	20.0	17.0	17.0	20.5	19.2	13.8	21.1
California	13.0	13.3	11.3	13.0	14.6	10.0	9.1	14.1	10.3	13.0
Oklahoma	......	......	11.3	11.4	13.0	19.0	14.9	13.3	19.0	16.4
Indian Territory	......	......	......	......	......	......	......	......	......	12.2
General average	13.38	11.44	13.19	13.72	12.35	13.43	15.33	12.27	12.29	15.0

Average yield of wheat in certain countries, in bushels per acre, 1894–1900.

Year.	United States.	Russia.	Germany.	Austria.	Hungary.	France.	United Kingdom.
	(a)	(b)	(b)	(b)	(b)	(a)	(a)
1894	13.2	10.8	25.1	17.4	18.2	20.1	31.7
1895	13.7	9.8	24.4	15.3	20.7	19.7	27.2
1896	12.4	9.0	26.4	15.9	19.4	20.0	34.7
1897	13.4	7.3	25.3	13.2	11.7	15.1	30.0
1898	15.3	9.8	27.2	18.0	17.1	21.1	35.8
1899	12.3	9.1	28.4	18.9	17.8	21.2	33.8
1900	12.3	8.1	27.9	15.5	16.9	19.2	29.5
Average	13.2	9.1	26.4	16.3	17.4	19.5	31.8

[a] Winchester bushels. [b] Bushels of 60 pounds.

Average value per acre of wheat in the United States, 1892–1901, by States.

States and Territories.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
Maine	$17.03	$16.32	$16.67	$15.74	$18.48	$17.49	$17.36	$20.47	$17.55	$23.18
New Hampshire	16.30	12.75	16.00	14.67	21.00	17.60	17.48	16.34	15.00	......
Vermont	16.51	14.28	15.21	20.01	22.79	17.68	20.25	18.70	18.33	17.58
Connecticut	14.53	......	......	......	......	20.00	17.60	17.39	17.05	......
New York	13.77	11.02	9.18	12.31	14.08	19.26	15.26	14.80	13.63	10.74
New Jersey	11.87	10.15	9.33	8.80	13.62	17.20	12.70	10.88	14.13	12.10
Pennsylvania	11.83	9.10	8.40	10.79	11.62	17.93	11.90	8.98	9.72	12.31
Delaware	9.75	8.82	7.15	7.42	15.66	20.21	9.18	8.70	14.21	13.13
Maryland	9.77	10.26	8.26	10.88	14.96	17.86	10.71	9.59	13.84	12.21
Virginia	7.22	7.06	5.32	6.05	7.44	11.04	9.31	5.80	8.57	7.96
North Carolina	6.32	5.90	3.25	4.97	6.06	7.52	7.18	5.49	7.87	7.13
South Carolina	6.04	6.17	4.87	5.63	6.05	10.27	9.96	6.44	9.09	8.62
Georgia	6.12	6.48	5.24	5.08	7.12	9.68	9.80	6.66	8.64	7.71
Alabama	6.23	7.22	6.47	6.00	6.80	10.10	10.80	6.76	8.45	7.66
Mississippi	6.12	6.55	7.35	4.88	6.97	9.90	11.54	6.01	8.06	7.57
Texas	9.23	6.09	8.15	8.76	8.78	14.06	10.06	7.55	11.78	6.94
Arkansas	6.56	5.20	4.84	5.55	5.68	8.82	6.38	5.50	6.57	6.86
Tennessee	6.46	5.24	4.13	5.46	6.29	10.64	8.84	6.79	7.82	7.99
West Virginia	8.03	8.28	7.26	7.31	8.03	11.93	9.80	6.60	7.55	8.39
Kentucky	7.91	6.44	6.25	6.65	6.61	12.10	9.55	6.01	8.97	8.71
Ohio	9.25	8.27	9.31	7.98	7.02	14.87	11.15	9.09	4.26	10.86
Michigan	9.85	7.52	8.22	7.92	10.75	13.57	13.31	5.46	5.24	7.88
Indiana	9.41	7.47	8.46	5.24	7.20	11.57	9.83	6.27	3.71	11.06
Illinois	10.21	5.87	8.19	5.83	10.88	7.03	6.60	6.30	8.32	12.14
Wisconsin	7.13	7.18	8.42	7.91	9.31	10.50	10.62	9.46	9.92	10.48
Minnesota	7.08	4.90	6.62	10.12	9.66	10.01	8.53	7.37	6.62	7.74
Iowa	6.90	5.64	7.40	8.97	9.92	9.75	8.68	7.15	9.20	9.75
Missouri	7.25	4.56	6.58	6.12	8.19	7.65	5.78	6.14	7.88	10.97
Kansas	9.05	3.53	4.58	3.47	6.68	11.47	7.10	5.10	9.73	10.92
Nebraska	6.25	3.48	3.43	4.80	8.12	10.00	7.71	5.05	6.36	9.23
South Dakota	6.38	3.74	3.04	4.56	6.94	5.52	6.20	5.85	4.00	6.84
North Dakota	6.34	4.13	5.07	7.98	7.55	7.62	7.31	6.53	2.84	7.07
Montana	14.84	12.90	13.39	17.45	17.49	22.10	17.11	15.68	16.23	17.76
Wyoming	11.55	12.15	12.35	16.64	15.19	17.50	16.35	12.60	13.38	16.91
Colorado	11.08	6.86	11.64	13.16	10.67	16.80	14.73	13.51	13.33	16.15
New Mexico	11.04	12.60	15.84	14.89	13.86	18.00	14.76	8.42	14.28	15.48
Arizona	12.17	11.38	17.00	13.33	18.40	13.32	29.16	9.79	11.53	18.53
Utah	10.73	8.28	11.66	9.86	18.02	14.28	15.12	10.97	11.49	14.35
Nevada	14.40	10.73	15.00	10.63	20.70	21.87	27.55	13.68	17.15	22.09
Idaho	13.20	11.58	9.48	8.37	15.93	15.40	15.81	12.10	9.57	12.93
Washington	9.98	9.74	6.47	6.35	13.32	15.98	13.07	11.58	11.99	13.67
Oregon	10.05	9.63	7.61	9.40	12.24	12.24	12.71	10.18	7.59	11.37
California	8.84	7.05	6.44	7.80	12.12	8.30	6.55	8.74	5.97	7.80
Oklahoma	......	......	5.76	5.47	8.84	14.44	7.75	7.05	10.07	10.33
Indian Territory	......	......	......	......	......	......	......	......	......	8.42
General average	8.35	6.16	6.48	6.99	8.97	10.86	8.92	7.17	7.61	9.37

California Fruits and Nuts.

During the last thirteen years the State of California has expended $15,000 in the effort to keep in check the insect enemies of the fruit grower. Hon. Ellwood Cooper, president of the State board of horticulture, in a recent address urged the board to ask for $10,000 for the coming year, as the pests are still costing the fruit growers of that State an aggregate of $300,000 per annum.

Two hundred and seventy-four carloads of almonds and 573 of walnuts represent the shipments from California for 1900.

There were 88,189½ tons of green deciduous fruits shipped out of the State of California in 1900 and 175,033½ tons of cured dried and canned deciduous fruits were exported from the State for the same period. These shipments were all made by rail and were exclusive of ocean shipments.

Warnings given the raisin growers of California by the United States Weather Bureau saved them great loss from unusual rains during the curing season of 1901.

One hundred and seventy-four million pounds of prunes represents the California crop of last year. This does not include the large additional product of other prune-growing sections of the Pacific coast, amounting to 9,960,000 pounds.

Average farm price of wheat per bushel in the United States December 1, 1892–1901, by States.

States and Territories.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
Maine	$1.02	$1.02	$0.79	$0.82	$0.84	$1.06	$0.89	$0.91	$0.90	$0.97
New Hampshire	1.00	.85	.80	.76	1.00	1.10	.92	.95	.92	......
Vermont	.96	.85	.67	.69	.93	1.01	.90	.85	.78	.94
Connecticut	.87	......	......	.68	......	1.00	.88	.95	.82	......
New York	.85	.76	.62	.68	.88	.90	.72	.80	.77	.82
New Jersey	.83	.70	.61	.71	.89	.93	.73	.75	.74	.72
Pennsylvania	.81	.65	.56	.65	.83	.91	.68	.66	.72	.72
Delaware	.75	.60	.55	.64	.87	.94	.69	.68	.70	.71
Maryland	.74	.76	.54	.64	.83	.93	.70	.68	.71	.71
Virginia	.76	.63	.56	.65	.80	.92	.66	.69	.72	.73
North Carolina	.89	.72	.65	.72	.83	.94	.78	.82	.82	.82
South Carolina	.93	.98	.87	.88	.89	1.18	.94	.99	1.01	.98
Georgia	.90	.90	.76	.82	.89	1.03	.98	.98	.95	.94
Alabama	.93	.88	.78	.80	.85	1.01	.90	.89	.89	.88
Mississippi	.90	.85	.75	.61	.82	.99	.83	.78	.84	.86
Texas	.75	.58	.54	.66	.75	.89	.68	.68	.64	.78
Arkansas	.80	.65	.55	.59	.71	.84	.58	.64	.65	.78
Tennessee	.68	.57	.51	.62	.74	.95	.67	.78	.79	.74
West Virginia	.75	.72	.60	.69	.78	.89	.71	.71	.77	.77
Kentucky	.67	.57	.50	.61	.76	.89	.62	.66	.69	.72
Ohio	.68	.57	.49	.60	.78	.88	.66	.64	.71	.71
Michigan	.67	.57	.52	.60	.84	.87	.64	.65	.69	.71
Indiana	.64	.53	.46	.57	.80	.89	.63	.64	.70	.70
Illinois	.63	.51	.45	.53	.74	.89	.60	.63	.64	.69
Wisconsin	.62	.54	.51	.51	.70	.84	.59	.61	.64	.65
Minnesota	.61	.51	.49	.44	.68	.77	.54	.55	.63	.60
Iowa	.60	.49	.50	.46	.62	.75	.52	.55	.59	.60
Missouri	.58	.48	.43	.51	.70	.85	.59	.62	.63	.69
Kansas	.52	.42	.44	.45	.63	.74	.50	.52	.55	.59
Nebraska	.50	.40	.49	.40	.58	.69	.47	.49	.53	.54
South Dakota	.51	.44	.46	.38	.62	.69	.50	.50	.58	.53
North Dakota	.52	.43	.43	.38	.64	.74	.51	.51	.58	.54
Montana	.69	.60	.54	.73	.66	.68	.58	.61	.61	.67
Wyoming	.66	.65	.63	.64	.62	.70	.69	.67	.76	.69
Colorado	.58	.52	.65	.56	.61	.70	.56	.57	.59	.67
New Mexico	.80	.75	.88	.73	.66	.75	.62	.61	.68	.72
Arizona	.78	.65	1.00	.65	.80	.74	.92	.64	.79	.85
Utah	.62	.60	.53	.44	.68	.68	.54	.53	.55	.70
Nevada	.75	.73	.75	.49	.69	.90	.95	.76	.70	.88
Idaho	.60	.60	.46	.47	.65	.70	.51	.50	.46	.61
Washington	.58	.48	.39	.41	.74	.68	.54	.51	.51	.47
Oregon	.64	.55	.43	.47	.72	.72	.62	.53	.55	.54
California	.68	.53	.57	.60	.83	.83	.72	.62	.58	.60
Oklahoma	......	......	.51	.48	.68	.76	.52	.53	.53	.63
Indian Territory	......	......	......	......	......	......	......	......	......	.69
General average	.624	.538	.491	.509	.726	.808	.582	.581	.619	.624

Transportation rates, average for wheat, in cents, St. Louis to New Orleans by river.

Year.	Bulk, per bushel.	Sacks, per 100 lbs.	Year.	Bulk, per bushel.	Sacks, per 100 lbs.	Year.	Bulk, per bushel.	Sacks, per 100 lbs.	Year.	Bulk, per bushel.	Sacks, per 100 lbs.
1877	8.11	20.04	1884	6.63	14.00	1890	6.58	15.66	1896	5.00	14.55
1878	7.19	17.36	1885	6.40	15.00	1891	6.88	16.28	1897	4.98	15.00
1879	7.75	18.00	1886	6.50	16.00	1892	6.50	16.87	1898	4.50	10.00
1880	8.25	19.00	1887	6.00	18.25	1893	6.55	17.54	1899	4.50	10.00
1881	6.00	20.00	1888	6.50	15.00	1894	5.89	17.14	1900	4.25	10.00
1882	6.42	20.00	1889	5.95	17.93	1895	5.95	12.50	1901	4.25	10.00
1883	5.50	17.75									

Wholesale prices of wheat per bushel in leading cities of the United States, 1896–1901.

Date.	New York.		Baltimore.		Chicago.		Detroit.		St. Louis.		Minneapolis.		San Francisco.	
	No. 2, red winter.		Southern, No. 2, red.				No. 2, red.		No. 2, red winter.		No. 2, northern.		No. 1, California (per cwt.).	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1896.														
January	\$0.68⅛	\$0.78¾	\$0.66	\$0.76	\$0.55¾	\$0.68⅞	\$0.65½	\$0.72¾	\$0.63	\$0.72	\$0.53½	\$0.58	\$1.01¼	\$1.12½
February	.78⅞	.82⅝	.74	.78	.62	.71¼	.72½	.75¾	.71	.74½	.59	.61½	1.12½	1.13¾
March	.76¾	.82⅝	.74	.78	.59⅞	.71	.68	.74¾	.67¾	.72½	.57¼	.61¼	1.07½	1.12½
April	.73⅝	.83⅜	.73	.78	.61¼	.71	.67¼	.75½	.65½	.72¾	.58¾	.62⅝	1.07½	1.07½
May	.71⅜	.75¾	.66	.74	.57⅛	.67⅝	.65	.69	.55¾	.68¼	.55⅞	.60½	1.05	1.07½
June	.63¾	.76⅛	.51	.68	.53⅝	.67	.58	.67½	.52¼	.60	.51⅝	.58⅛	.96¼	1.02½
July	.62	.67½	.53	.64½	.54¼	.62¼	.57½	.64¾	.52½	.58¾	.52⅛	.55⅝	.92⅛	.95
August	.64¾	.68⅛	.57	.65⅛	.53	.63⅛	.61½	.64⅞	.58	.64	.50	.54¾	.93¾	.96¼
September	.65	.77⅝	.59	.71¾	.55	.70	.59⅝	.71	.56¼	.58¼	.51	.64	.96¼	1.06¼
October	.77⅛	.90½	.69	.84	.65½	.81¼	.70½	.84½	.68	.80½	.63½	.75	1.15	1.83¾
November	.85¾	1.02⅝	.76	.96	.71	.94⅜	.80½	.97	.76	.91	.73	.81½	1.48¾	1.50
December	.99⅞	1.06⅞	.88	.96	.74⅝	.93⅛	.90	.96¾	.89	.92⅝	.74⅛	.80⅝	1.47½	1.50
1897.														
January	.91¾	1.01⅜	.87	.97	.71¼	.91	.85	.94¾	.80	.92½	.71⅝	.79⅜	1.50	1.56¼
February	.88¼	.96¾	.87	.92	.71⅜	.87⅞	.85	.89	.80⅞	.89⅛	.71⅛	.73⅝	1.32½	1.40
March	.81⅝	.89⅛	.83	.92	.69⅝	.90¼	.85	.91½	.90⅞	.95⅛	.69⅝	.74½	1.28¾	1.36¼
April	....	....	.73	.85	.64⅛	.97	.83½	.93¾	.90	1.03	.65¼	.77⅝	1.21¼	1.30
May	....	....	.80	.90	.68¾	.97⅞	.79½	.92½	.82½	.97	.69¼	.75	1.30	1.32½
June	....	....	.55	.81	.66⅞	.83½	.76	.83	.74	.84½	.68½	.71⅞	1.22½	1.23¾
July	....	....	.50	.85	.68¼	.79¾	.74½	.79¼	.65½	.79	.69¾	.79¾	1.21¼	1.40
August	.86⅝	1.11¼	.80	1.07½	.75¼	1.07	.77½	1.01	.79	1.03	.79¾	1.07½	1.46¼	1.55
September	.94⅛	1.07⅛	.89	1.04¼	.85½	1.01¼	.91½	1.00	.93¼	1.01	.85	.96¼	1.47½	1.56¼
October	.94⅜	1.05	.88	1.01	.87⅞	.99¼	.91	.97½	.93½	1.01	.85	.92½	1.45	1.47½
November	.97¾	1.03½	.90	1.01	.91	1.00½	.91	.97	.94¾	.99¾	.87¼	.92½	1.40	1.48¾
December	.97	1.03¼	.91	1.00	.92	1.09	.89¼	.94½	.95½	1.02	.86⅝	.93¼	1.40	1.42½
1898.														
January	.99¾	1.10⅜	.90	1.01¼	.89½	1.10	.90	.97¾	.92½	1.00½	.87½	.96	1.37½	1.41¼
February	1.02¼	1.10¼	.93	1.04	.95	1.08	.93½	.99¼	.94¾	1.01	.92¾	1.00	1.41¼	1.42½
March	.99⅞	1.08⅞	.94	1.03	1.00	1.06¾	.94¼	.98½	.96	1.00	.94½	.99½	1.40	1.46¼
April	1.01	1.28	.95	1.15	1.01	1.23½	.94½	1.12½	.97	1.10	.95¼	1.16¾	1.48¾	1.80
May	1.16½	1.93½	1.10	1.46½	1.17	1.85	1.10	1.60	1.00	1.27	1.14½	1.55	1.60	1.77½
June	.82	1.21	.60	1.16¼	.75	1.20	.82	1.12	.69	1.00½	.80	1.30	1.60	1.77½
July	.74⅛	.94	.62	.87	.65¾	.88	.66⅛	.90	.64⅛	.79	.80	.87½	1.22½	1.25
August	.73⅛	.81¾	.60	81	.65⅛	.75	.67	.74	.64	.73	.70	.87	1.08¾	1.20
September	.68¾	.79⅞	.60	73¼	.62¾	.68	.67	.70	.65	.70	.55	.63	1.10	1.18¾
October	.72	.80¼	.63	77½	.62	.70¼	.65⅛	.74	.65¾	.72¾	.56	.67	1.15	1.22½
November	.74¾	.78¾	.65	74	.64⅛	.69⅛	.69	.71¾	.67⅛	.71⅞	.60	.63	1.15	1.21¼
December	.73⅞	.81½	.62	77	.62¾	.70	.66¾	.72¼	.68⅛	.73	.60	.67	1.13¾	1.15

1899.														
anuary	.79¼	.87⅞	.76	.81⅛	.66½	.76	.70½	.76½	.71	.79½	.65⅛	.72¼	1.12½	1.18¾
February	.81	.87⅜	.74½	.78	.69¾	.74½	.72¼	.74¼	.72⅛	.76	.67⅝	.69¼	1.10	1.13¾
March	.78⅝	.87⅛	.72	.78	.66	.74⅛	.69	.75	.69	.76	.64	.70¼	1.06¼	1.15
April	.79⅞	.85¼	.75½	.79½	.70	.76½	.71½	.76⅝	.73⅝	.80	.68	.72	1.05	1.10
May	.80⅕	.87⅛	.73¼	.79½	.68⅜	.79⅛	.73¼	.80	.73¼	.81⅝	.67¼	.73	1.06¼	1.12½
June	.80	.85⅞	.75	.79	.71¼	.79¼	.75¼	.80¼	.73¾	.78½	.70½	.73⅞	1.10	1.12½
July	.75⅞	.81¾	.71	.75¾	.68⅝	.75⅞	.71¼	.78	.69⅝	.75	.65⅞	.71¾	1.05	1.10
August	.74⅜	.78¼	.71	.73¼	.69	.74⅛	.70	.74	.68⅛	.73¼	.66	.70¼	1.03¾	1.07½
September	.73¾	.77⅝	.70½	.74½	.69⅜	.75⅛	.70⅛	.73½	.68	.72	.64⅞	.67⅞	1.02½	1.07½
October	.75	.78¾	.71	.75½	.68⅞	.74¾	.70⅞	.73⅝	.69½	.73	.64¾	.69½	1.07½	1.12½
November	.72¼	.75⅝	.68½	.72	.65	.71⅛	.67½	.70¾	.68½	.70⅛	.61¾	.64	.97½	1.07½
December	.72⅛	.76	.70	.72	.64	.69½	.68	.72	.69½	.72	.60	.64	.96¼	.98¾
											No. 1, northern.			
1900.														
January	.72⅞	.78⅜	.70	.73	.61⅛	.67⅛	.66¾	.72	.66¼	.72	.62	.66¼	.95	.98¾
February	.74¾	.79⅞	.73	.76	.63⅞	.67½	.70¾	.73¼	.69	.71¾	.63	.65⅞	.96¼	1.00
March	.74½	.81⅝	.71½	.75½	.64	.67	.70¼	.72½	.69	.72¼	.63⅛	.66	.95	.96¼
April	.78	.81¼	.71½	.76	.64¾	.67¾	.71	.72¾	.70	.72¾	.64⅛	.66⅛	.95	.96¼
May	.78	.82¾	.72	.73½	.63⅝	.67¼	.71¾	.74	.70¼	.71¼	.64⅛	.66⅛	.90	.95
June	.80	.96⅞	.72	.90	.65⅞	.87⅛	.73¼	.91½	.68¾	.86½	.64⅞	.88⅞	.91¼	1.07½
July	.81	.90¼	.73	.81½	.74	.81½	.77½	.84⅛	.71⅞	.80⅛	.74¾	.82¼	1.05	1.07½
August	.78¼	.83⅜	.71	.76	.71¾	.76¼	.74	.78¾	.68¾	.73	.72¼	.76	1.02½	1.05
September	.79¼	.85	.71¾	.77	.72⅛	.79⅜	.75¼	.80¾	.71	.77⅛	.73½	.81¼	1.03¾	1.05
October	.76⅞	.82⅞	.71¼	.77	.71⅜	.77⅜	.75	.79½	.69	.75½	.73⅞	.80¼	.95	1.01¼
November	.77½	.81¼	.71¾	.73¾	.69⅝	.74¼	.74¼	.77½	.69½	.72¾	.72¾	.76⅝	.97½	1.00
December	.77⅝	.83⅛	.71⅛	.75⅛	.69¼	.74⅝	.74½	.81	.69¾	.71¼	.71⅞	.75¼	.96¼	.97½
1901.														
January	.79⅛	.83⅓	.73¾	.78	.71⅜	.76⅝	.78	.82½	.72	.77	.73	.77½	.97½	1.01¼
February	.79¾	.81¼	.76	.78¾	.72⅛	.71¾	.78½	.80¼	.73½	.75¾	.73	.74⅜	.95	.98¾
March	.80⅛	.82¼	.77¾	.81	.73¼	.76¼	.78½	.80	.74	.75¾	.73	.74⅝	.95	1.02⅛
April	.78⅛	.84¾	.76⅛	.81⅛	.69½	.74⅞	.74	.78	.71	.76¼	.70¼	.74⅛	1.00	1.05
May	.81¾	.84⅞	.78¾	.80½	.70	.75⅛	.74½	.77¼	.73⅛	.76	.70⅞	.74¼	.97½	1.01¼
June	.75½	.85¼	.72	.79½	.65½	.77¼	.67¾	.77¼	.63¼	.75⅛	.62⅞	.74¾	.96¼	1.00
July	.72¾	.79¼	.69¼	.75⅛	.63⅛	.71⅝	.66½	.74	.61¼	.70¾	.60½	.69¾	.95	1.00
August	.76	.80½	.72	.78	.66⅝	.77	.68¼	.76⅛	.66¼	.73⅞	.66	.71⅛	.97½	.98¾
September	.75⅜	.77⅜	.78⅛	.75½	.68⅛	.71	.70½	.73½	.70⅝	.72⅛	.66¾	.69⅛	.96¼	.97½
October	.74⅝	.80⅝	.70½	.75	.66¾	.71⅛	.70	.74	.70⅛	.73½	.66	.68⅞	.95	.98¾
November	.80½	.83⅛	.74¼	.78	.70	.73¾	.73	.79½	.72¼	.80	.68⅛	.71½	.98¾	1.01¼
December	.84¾	.89⅞	.78⅛	.85¾	.73	.79⅛	.79	.90½	.81	.88½	.71¾	.77	1.01¼	1.06¼

Monthly average prices of wheat in Chicago. [a]

[Cents per bushel.]

Month.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
January	76 5/16	91 3/8	87 1/4	75 1/16	61 7/16	55 1/8	62 5/16	82 3/8	99 9/16	71 1/4	64 5/16	73 7/8
February	75 5/8	95 1/8	87 15/16	73 15/16	57 1/2	53 7/8	66 3/8	79 5/8	101 1/2	72 1/8	65 11/16	73 7/16
March	78 9/16	101 5/16	84 1/8	76	57 13/16	57 1/16	65 7/16	79 13/16	103 3/8	70 1/4	65 5/8	74 3/4
April	84 7/8	109 1/16	81 5/16	79	61 1/8	61 1/2	66 1/8	80 9/16	112 1/4	73 1/4	66 1/4	72 3/16
May	94 7/8	103 7/16	82 7/8	72 1/4	56 9/16	73 1/16	62 3/8	83 5/16	151	73 15/16	65 9/16	72 9/16
June	88 1/8	96 1/4	82 7/8	65 1/16	58 9/16	76 9/16	60 5/16	75 3/16	97 1/2	75 1/4	76 11/16	71 3/8
July	89 5/8	91 1/8	78 1/4	60 1/8	55 7/16	68	58 1/4	74	76 7/8	72	77 3/4	67 7/16
August	98 15/16	99 15/16	77 1/16	59 5/8	55	65 3/8	58 1/16	91 1/8	70 1/4	71 3/4	74	71 13/16
September	100 1/8	95 1/4	73 1/8	66 3/16	53	60 1/16	62 1/8	93 3/8	65 3/8	72 1/4	75 15/16	69 9/16
October	99 5/8	95 3/4	71 15/16	63 5/8	53 13/16	60 7/8	73 3/8	93 9/16	66 1/8	71 9/16	74 5/8	69 1/8
November	94 15/16	94 1/8	71 9/16	60 7/8	56 1/8	58 7/8	82 11/16	95 3/4	67	68 1/4	71 15/16	71 7/8
December	90 1/8	91 13/16	71 1/4	61 13/16	58 3/16	59 1/4	83 7/8	100 1/8	66 3/8	66 3/4	71 15/16	76 1/4
Yearly average	89 5/16	97 1/16	79 1/8	67 3/4	57 1/16	62 3/8	66 13/16	85 3/4	89 3/4	71 1/2	70 13/16	72

[a] This table exhibits average cash prices for the past twelve years. The monthly prices are the means between the lowest and highest prices for each month, and the yearly prices are the averages of the monthly averages.

OATS.

The range of prices of oats for the year 1901 was the highest in ten years, and the yearly average at Chicago was 32 cents per bushel. Wholesale cash prices were fairly steady during the first half of the year, and prices moved within narrow limits. In the last six months conditions were most decidedly changed, and an unusual advance of 20¾ cents took place in the Chicago market, from 27½ cents in July to 48¼ cents, the highest point of the year, in December. Other markets reported follow the Chicago figures approximately.

Oat crops of the countries named, 1897–1901.

Country.	1897.	1898.	1899.	1900.	1901.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States	698,768,000	730,907,000	796,178,000	809,126,000	736,809,000
Ontario	89,038,000	89,596,000	92,731,000	92,520,000	80,803,000
Manitoba	10,965,000	17,854,000	23,022,000	9,092,000	28,673,000
Rest of Canada	12,000,000	13,000,000	14,000,000	12,000,000	12,000,000
Total Canada	112,003,000	120,450,000	129,753,000	113,612,000	121,476,000
Total North America	810,771,000	851,357,000	925,931,000	922,738,000	858,285,000
Great Britain	120,530,000	122,669,000	118,363,000	118,467,000	113,576,000
Ireland	48,181,000	55,348,000	53,013,000	61,291,000	62,240,000
Total United Kingdom	168,711,000	178,017,000	171,376,000	179,758,000	175,816,000
Sweden	58,473,000	70,416,000	53,698,000	69,272,000	56,971,000
Denmark	35,220,000	41,474,000	37,074,000	40,323,000	30,000,000
Netherlands	16,125,000	16,618,000	16,061,000	16,000,000	16,000,000
Belgium	29,794,000	35,078,000	29,047,000	35,815,000	34,288,000
France	227,595,000	278,277,000	270,437,000	250,597,000	213,604,000
Spain	10,751,000	8,833,000	12,776,000	10,000,000	12,000,000
Italy	19,599,000	18,567,000	16,504,000	16,000,000	15,000,000
Germany	393,983,000	465,321,000	474,179,000	488,594,000	485,716,000
Austria	96,164,000	114,189,000	122,168,000	118,181,000	118,191,000
Hungary	55,063,000	78,708,000	81,217,000	70,946,000	67,811,000
Croatia-Slavonia	4,399,000	7,022,000	6,316,000	5,564,000	4,940,000
Total Austria-Hungary	155,626,000	199,919,000	209,701,000	194,691,000	190,942,000
Roumania	9,852,000	17,410,000	6,255,000	8,704,000	16,540,000
Bulgaria	8,000,000	10,662,000	5,775,000	6,000,000	8,000,000
Russia proper	547,323,000	559,920,000	839,639,000	744,037,000	527,576,000
Poland	41,585,000	55,515,000	56,463,000	51,235,000	56,150,000
North Caucasus	6,695,000	12,416,000	12,546,000	17,519,000	11,932,000
Total Russia in Europe	595,603,000	627,851,000	908,648,000	812,791,000	595,658,000
Total Europe	1,729,332,000	1,968,443,000	2,211,531,000	2,128,545,000	1,850,535,000

Oat crops of the countries named, 1897–1901—Continued.

Country.	1897.	1898.	1899.	1900.	1901.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Siberia	59,550,000	51,258,000	76,853,000	34,918,000	21,569,000
Central Asia	8,559,000	8,423,000	9,804,000	5,987,000	6,870,000
Total Russia in Asia	68,109,000	59,681,000	86,657,000	40,905,000	28,439,000
Total Asia	68,109,000	59,681,000	86,657,000	40,905,000	28,439,000
Algeria	4,092,000	6,023,000	4,534,000	5,000,000	6,000,000
Cape Colony	936,000	1,493,000	1,868,000	1,750,000	1,750,000
Total Africa	5,028,000	7,516,000	6,402,000	6,750,000	7,750,000
West Australia	19,000	30,000	58,000	76,000	90,000
South Australia	196,000	211,000	314,000	225,000	378,000
Queensland	33,000	32,000	4,000	11,000	8,000
New South Wales	861,000	561,000	287,000	648,000	612,000
Victoria	7,032,000	4,961,000	5,697,000	6,309,000	9,884,000
Tasmania	1,003,000	1,137,000	2,343,000	1,184,000	1,451,000
New Zealand	11,587,000	10,045,000	17,032,000	16,840,000	19,687,000
Total Australasia	20,731,000	16,977,000	25,735,000	25,293,000	32,110,000

RECAPITULATION BY CONTINENTS.

North America	810,771,000	851,357,000	925,931,000	922,738,000	858,285,000
Europe	1,729,332,000	1,968,443,000	2,211,531,000	2,128,545,000	1,850,535,000
Asia	68,109,000	59,681,000	86,657,000	40,905,000	28,439,000
Africa	5,028,000	7,516,000	6,402,000	6,750,000	7,750,000
Australasia	20,731,000	16,977,000	25,735,000	25,293,000	32,110,000
Total	2,633,971,000	2,903,974,000	3,256,256,000	3,124,131,000	2,777,119,000

Visible supply of oats in the United States first of each month for ten years.[a]

Month.	1892–1893.	1893–1894.	1894–1895.	1895–1896.	1896–1897.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	6,775,000	4,805,000	3,134,000	9,007,000	14,120,000
August	6,889,000	2,627,000	2,135,000	4,653,000	10,384,000
September	7,268,000	4,846,000	9,380,000	4,673,000	11,410,000
October	9,459,000	5,324,000	10,765,000	4,124,000	13,821,000
November	11,712,000	7,252,000	12,738,000	8,020,000	17,217,000
December	10,997,000	6,602,000	12,332,000	10,248,000	17,905,000
January	9,809,000	5,602,000	11,864,000	10,446,000	19,538,000
February	9,282,000	5,371,000	10,508,000	11,446,000	19,978,000
March	8,618,000	4,089,000	9,227,000	12,211,000	20,832,000
April	7,174,000	3,938,000	8,905,000	14,326,000	20,672,000
May	6,168,000	3,761,000	7,823,000	13,426,000	16,138,000
June	5,839,000	3,401,000	11,284,000	13,460,000	12,878,000

Month.	1897–1898.	1898–1899.	1899–1900.	1900–1901.	1901–1902.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	12,912,000	8,716,000	10,262,000	12,716,000	15,275,000
August	9,604,000	4,971,000	6,885,000	9,364,000	7,808,000
September	13,784,000	7,360,000	10,973,000	13,853,000	10,603,000
October	15,573,000	9,286,000	13,127,000	17,140,000	14,445,000
November	20,096,000	11,852,000	13,254,000	20,528,000	12,899,000
December	19,768,000	9,460,000	11,789,000	18,136,000	10,109,000
January	16,148,000	10,893,000	12,004,000	15,861,000	8,680,000
February	20,245,000	13,231,000	11,876,000	16,175,000	8,537,000
March	17,925,000	14,782,000	12,449,000	16,800,000	8,207,000
April	15,609,000	15,725,000	14,176,000	15,823,000	6,606,000
May	14,402,000	13,971,000	13,845,000	16,824,000	5,010,000
June	10,421,000	13,661,000	12,301,000	14,989,000	....

[a] These figures represent stocks available at 62 of the principal points of accumulation east of the Rocky Mountains, stocks in Manitoba elevators, and stocks afloat on lakes and canals.

Condition of oat crop of United States, 1886–1901.

Year.	June.	July.	August.	September.	Year.	June.	July.	August.	September.	Year.	June.	July.	August.	September.
1886	95.9	88.8	87.4	90.9	1892 ...	88.5	87.2	86.2	78.9	1897 ...	89.0	87.5	86.0	84.6
1887	91.0	85.9	85.6	83.4	1893 ...	88.9	88.8	78.3	74.9	1898 ...	98.0	92.8	84.2	79.0
1888	95.4	95.2	91.7	87.2	1894 ...	87.0	77.7	76.5	77.8	1899 ...	88.7	90.0	90.8	87.2
1889	93.3	94.1	92.3	90.0	1895 ...	84.3	83.2	84.5	86.0	1900 ...	91.7	85.5	85.0	82.9
1890	89.8	81.6	70.1	64.4	1896 ...	98.8	96.3	77.3	74.0	1901 ...	85.3	83.7	73.6	72.1
1891	85.1	87.6	89.5	90.7										

Acreage, production, value, prices, exports, etc., of oats of the United States, 1866–1901.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1	Farm value Dec. 1.	Chicago cash price per bushel, No. 2. December. Low.	December. High.	May of following year. Low.	May of following year. High.	Domestic exports, including oatmeal, fiscal years beginning July 1.*	Imports during fiscal years beginning July 1.*
	Acres.	*Bush.*	*Bushels.*	*Cts.*	*Dollars.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Bushels.*	*Bushels.*
1866	8,864,219	30.2	268,141,078	35.1	94,057,945	36	43	59	78	825,895	778,198
1867.....	10,746,416	25.9	278,698,000	44.5	123,902,556	52	57¼	......	......	122,554	780,798
1868.....	9,665,736	26.4	254,960,800	41.7	106,355,976	43	49⅛	56¾	62⅛	481,871	326,659
1869.....	9,461,441	30.5	288,334,000	38.0	109,521,734	40	44¾	46⅛	53⅛	121,517	2,266,785
1870.....	8,792,395	28.1	247,277,400	39.0	96,443,637	37¾	41	47¼	51	147,572	599,514
1871.....	8,365,809	30.6	255,743,000	36.2	92,591,359	30¾	33	34¾	42⅛	262,975	535,250
1872.....	9,000,769	30.2	271,747,000	29 9	81,303,518	23⅛	25¾	30	34	714,072	225,555
1873.....	9,751,700	27.7	270,340,000	34.6	93,474,161	34	40⅝	44	48⅛	812,873	191,802
1874.....	10,897,412	22.1	240,369,000	47.1	113,133,934	51½	54⅛	57¼	64⅛	504,770	1,500,040
1875.....	11,915,075	29.7	354,317,500	32.0	113,441,491	29⅛	30⅛	28⅝	31⅛	1,466,228	121,547
1876.....	13,358,908	24.0	320,884,000	32.4	103,844,896	31¾	34⅛	37¼	45¾	2,854,128	41,597
1877.....	12,826,148	31.7	406,394,000	28.4	115,546,194	24⅛	27	23	27	3,715,479	21,391
1878.....	13,176,500	31.4	413,578,560	24.6	101,752,468	19⅝	20⅝	24⅜	30⅛	5,452,136	13,395
1879.....	12,683,500	28.7	363,761,320	33.1	120,533,294	32¾	36¾	29⅛	34⅞	766,366	489,576
1880.....	16,187,977	25.8	417,885,380	36.0	150,243,565	29⅛	33⅛	36¼	39⅛	402,904	64,412
1881.....	16,831,600	24.7	416,481,000	46.4	193,198,970	43⅛	40¾	48¾	56⅜	625,690	1,850,983
1882.....	18,494,691	26.4	488,250,610	37.5	182,978,022	34¾	41⅛	38¾	42¾	461,496	815,017
1883.....	20,324,962	28.1	571,302,400	32.7	187,040,264	29⅝	36⅛	30¾	34¼	3,274,622	121,069
1884.....	21,300,917	27.4	583,628,000	27.7	161,528,470	22⅛	25¼	34⅛	37	6,203,104	94,810
1885.....	22,783,630	27.6	629,409,000	28.5	179,631,860	27	29	26¼	29⅝	7,311,306	149,480
1886.....	23,658,474	26.4	624,134,000	29.8	186,137,930	25¾	27¼	25⅛	27⅛	1,374,635	189,575
1887.....	25,920,906	25.4	659,618,000	30.4	200,699,790	28⅝	30⅞	32⅛	38	573,080	123,817
1888.....	26,998,282	26.0	701,735,000	27.8	195,424,240	25	26⅞	21⅜	23⅜	1,191,471	131,501
1889.....	27,462,316	27.4	751,515,000	22.9	171,781,008	20	21	24¾	30	15,107,238	153,232
1890.....	26,431,369	19.8	523,621,000	42.4	222,018,486	39⅞	43⅞	45¼	51	1,882 836	41,848
1891.....	25,581,861	28.9	738,394,000	31.5	232,312,267	31⅛	33⅝	28⅜	33⅛	10,586,644	47,782
1892.....	27,063,835	24.4	661,035,000	31.7	209,253,611	25⅝	31¼	28¾	32¼	2,700,793	49,433
1893.....	27,273,033	23.4	638,854,850	29.4	187,576,092	27⅛	29⅛	32⅛	36	6,290,229	31,759
1894.....	27,023.553	24.5	662,036,928	32.4	214,816,920	28¾	29⅝	27⅛	30¾	1,708,824	330,318
1895.....	27,878,406	29.6	824,443,537	19.9	163,655,068	16⅝	17⅛	18	19⅝	15,156,618	66,602
1896.....	27,565,985	25.7	707,346,404	18.7	132,485,033	16⅛	18¾	16⅞	18¾	37,725,083	131,204
1897.....	25,730,375	27.2	698,767,809	21.2	147,974,719	21	23⅞	26	32	73,880,307	25,093
1898.....	25,777,110	28.4	730,906,643	25.5	186,405,364	26	27¾	24	27¾	33,534,362	28,098
1899.....	26,341,380	30.2	796,177,713	24.9	198,167,975	22¼	23	21¼	23¾	45,048,857	54,576
1900.....	27,364,795	29.6	809,125,989	25.8	208,669,233	21¾	22¾	26	29⅝	42,168,931	33,091
1901.....	28,541,476	25.8	736,808,724	39.9	293,658,777	42	48¼	......	......	....	....

* In years 1866 to 1882, inclusive, oatmeal is not included.

Acreage, production, value, and distribution of oats of the United States in 1901, by States.

States and Territories.	Crop of 1901.			Stock on hand March 1, 1902.		Shipped out of county where grown.
	Acreage.	Production.	Value.			
	Acres.	*Bushels.*	*Dollars.*	*Bushels.*	*Per cent.*	*Bushels.*
Maine	115,308	4,035,780	2,017,890	1,372,165	34	80,716
New Hampshire	12,303	362,938	188,728	90,734	25	3,629
Vermont	76,255	2,516,415	1,258,208	981,402	39	....
Massachusetts	6,788	210,428	115,735	44,190	21	....
Rhode Island	1,609	47,305	25,545	10,880	23	473
Connecticut	10,284	295,151	159,382	70,836	24	....
New York	1,298,592	28,049,587	13,463,802	8,134,380	29	560,992
New Jersey	72,183	1,154,928	542,816	346,478	30	92,394
Pennsylvania	1,246,331	23,555,656	10,600,045	8,244,480	35	706,670
Delaware	5,461	101,028	45,463	30,308	30	15,154
Maryland	44,350	833,780	341,850	150,080	18	100,054
Virginia	249,521	3,717,863	1,561,502	1,078,180	29	223,072
North Carolina	253,344	3,648,154	1,860,559	693,149	19	72,963
South Carolina	235,371	3,718,862	2,305,694	260,320	7	74,377
Georgia	296,644	4,390,331	2,941,522	526,840	12	87,807
Florida	31,633	414,392	298,362	74,591	18	4,144
Alabama	219,440	3,181,880	2,036,403	350,007	11	31,819
Mississippi	121,051	1,839,975	1,159,184	202,397	11	....
Louisiana	31,756	425,530	255,318	42,553	10	....
Texas	838,195	13,662,578	8,197,547	1,366,258	10	273,252
Arkansas	254,970	3,136,131	1,787,595	470,420	15	31,361
Tennessee	200,076	3,501,330	1,575,598	805,306	23	245,093
West Virginia	87,361	1,633,651	702,470	424,749	26	65,346
Kentucky	273,048	5,379,046	2,205,409	1,344,762	25	161,371
Ohio	1,118,012	35,217,378	13,734,777	11,269,561	32	8,452,171
Michigan	991,207	28,745,003	11,785,451	10,348,201	36	6,611,351
Indiana	1,385,770	39,633,022	15,060,548	10,700,916	27	13,078,897
Illinois	3,990,493	112,531,903	45,012,761	33,759,571	30	31,508,933
Wisconsin	2,290,288	66,647,381	25,992,479	23,993,057	36	9,330,633
Minnesota	2,047,789	65,734,027	22,349,569	21,692,229	33	9,860,104
Iowa	4,104,180	122,304,564	44,029,643	36,691,369	30	36,691,369
Missouri	910,513	10,197,746	4,385,031	2,039,549	20	203,955
Kansas	931,850	17,332,410	7,452,936	5,026,399	29	693,296
Nebraska	1,972,991	39,065,222	14,454,132	14,063,480	36	9,766,306
South Dakota	678,974	19,554,451	6,648,513	7,821,780	40	2,150,990
North Dakota	723,207	23,576,548	7,780,261	11,080,978	47	1,886,124
Montana	147,365	6,189,330	2,228,159	2,228,159	36	1,485,439
Wyoming	33,499	1,373,459	659,260	302,161	22	....
Colorado	135,224	4,570,571	2,285,286	1,234,054	27	1,371,171
New Mexico	16,749	529,268	317,561	74,098	14	26,463
Arizona	1,780	62,300	37,380	4,361	7	3,738
Utah	45,424	1,498,992	764,486	299,798	20	209,859
Nevada	5,524	237,532	166,272	47,506	20	4,751
Idaho	78,703	3,014,325	1,326,303	542,578	18	1,115,300
Washington	148,083	7,033,942	2,461,880	2,110,183	30	2,110,183
Oregon	284,803	8,971,294	3,050,240	2,422,249	27	2,870,814
California	160,768	4,887,347	2,150,433	733,102	15	977,469
Oklahoma	191,200	3,957,840	1,978,920	910,303	23	158,314
Indian Territory	165,206	4,130,150	1,899,869	991,236	24	....
United States	28,541,476	736,808,724	293,658,777	227,502,343	30.9	143,398,317

Average yield per acre of oats in the United States, 1892–1901, by States.

States and Territories.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	32.2	36.3	33.5	40.1	40.0	31.0	36.0	35.0	37.5	35.0
New Hampshire	34.0	34.2	31.1	36.9	38.0	35.0	33.0	35.0	32.6	29.5
Vermont	35.5	36.4	32.9	43.8	40.5	33.0	38.0	37.0	34.9	33.0
Massachusetts	30.4	34.3	31.9	36.0	36.0	32.0	32.0	33.0	36.8	31.0
Rhode Island	29.4	28.2	30.0	32.4	30.0	32.0	27.0	26.0	30.9	29.4
Connecticut	25.3	25.0	25.8	31.9	29.0	29.0	28.2	28.0	31.0	28.7
New York	28.0	24.0	22.1	31.7	33.0	31.0	27.5	31.0	27.9	21.6
New Jersey	25.7	23.9	28.4	35.5	34.0	25.0	19.6	24.0	29.6	16.0
Pennsylvania	25.2	26.8	22.3	31.7	31.0	28.2	23.3	33.0	31.1	18.9
Delaware	19.3	25.4	19.0	19.1	29.0	22.0	22.0	20.0	21.0	18.5
Maryland	19.0	21.2	21.4	26.2	24.0	24.0	19.5	23.0	24.0	18.8
Virginia	11.2	17.5	12.0	17.7	18.5	12.0	16.1	14.0	14.8	14.9
North Carolina	9.7	14.1	10.9	15.1	12.0	13.0	14.3	12.0	13.9	14.4
South Carolina	10.5	11.8	12.0	15.2	11.0	15.5	17.2	12.0	15.5	15.8
Georgia	10.7	13.3	13.4	14.5	12.0	14.0	16.6	9.0	15.0	14.8
Florida	9.8	11.8	11.8	10.2	12.0	9.0	15.4	9.0	11.3	13.1
Alabama	10.2	14.2	13.2	14.9	14.0	13.0	16.8	10.0	14.4	14.5
Mississippi	10.6	15.5	13.0	15.7	13.0	14.0	18.5	10.0	14.0	15.2
Louisiana	12.2	16.0	22.3	15.0	10.0	18.0	18.1	18.0	18.0	13.4
Texas	24.5	25.1	32.7	20.7	20.0	25.0	29.7	25.0	38.0	16.3
Arkansas	15.7	19.3	18.5	25.4	16.0	17.0	22.8	19.0	22.2	12.8
Tennessee	13.5	18.4	14.6	22.5	16.5	10.0	18.7	14.0	16.6	17.5
West Virginia	17.5	23.5	18.5	23.4	24.0	20.0	19.5	23.0	21.0	18.7
Kentucky	18.3	22.2	21.0	26.2	21.0	18.0	22.4	18.0	21.3	19.7
Ohio	26.3	28.6	30.3	31.7	31.0	32.0	30.9	36.0	38.0	31.5
Michigan	28.7	26.0	26.1	23.9	30.0	26.0	32.8	34.0	36.7	29.0
Indiana	26.5	27.5	32.3	22.9	29.0	30.2	29.2	32.0	32.7	28.6
Illinois	26.3	27.2	36.1	24.4	28.0	32.0	29.0	38.0	38.0	28.2
Wisconsin	30.2	27.6	32.9	33.8	33.4	34.0	36.1	36.0	32.0	29.1
Minnesota	27.3	24.8	28.1	39.9	33.0	26.0	36.3	32.0	25.2	32.1
Iowa	25.4	24.8	25.6	46.2	27.5	30.0	34.0	33.0	34.0	29.8
Missouri	20.0	23.4	23.3	27.7	18.0	22.0	17.0	25.0	27.4	11.2
Kansas	28.5	18.5	17.9	17.9	13.0	24.0	18.0	29.0	31.6	18.6
Nebraska	26.7	15.0	12.6	23.8	19.0	31.0	32.1	30.0	21.8	19.8
South Dakota	26.3	21.5	7.6	25.3	27.5	22.0	26.8	26.0	21.5	28.8
North Dakota	26.5	21.9	25.9	32.1	22.0	23.0	30.7	30.0	10.3	32.6
Montana	28.8	34.0	40.1	35.8	47.0	42.0	40.6	38.0	39.0	42.0
Wyoming	28.6	24.0	30.4	41.0	32.0	35.0	31.2	30.0	34.2	41.0
Colorado	28.7	26.7	13.5	34.3	28.0	34.0	35.8	27.0	32.8	33.8
New Mexico	20.3	29.2	35.0	39.9	27.0	35.5	38.8	24.0	30.1	31.6
Arizona	......	......	......	......	......	......	......	......	......	35.0
Utah	26.5	27.9	33.0	33.8	38.0	35.0	39.7	34.0	35.9	33.0
Nevada	......	......	......	......	......	......	......	......	......	43.0
Idaho	29.0	33.1	38.5	35.2	42.0	36.3	43.6	34.0	36.6	38.3
Washington	34.5	39.7	36.5	40.3	36.0	48.0	41.9	37.0	34.4	47.5
Oregon	26.5	28.5	26.7	28.8	21.0	32.0	27.0	30.0	18.5	31.5
California	29.3	25.5	35.6	28.1	31.0	18.0	33.0	31.0	24.6	30.4
Oklahoma	......	......	......	......	......	......	......	......	......	20.7
Indian Territory	......	......	......	......	......	......	......	......	......	25.0
General average	24.43	23.42	24.50	29.57	25.66	27.16	28.35	30.23	29.6	25.8

Average yield of oats in certain countries, in bushels per acre, 1894–1900.

Year.	United States.	Russia.	Germany.	Austria.	Hungary.	France.	United Kingdom.
	(a)	(b)	(b)	(b)	(b)	(a)	(a)
1894	24.5	21.7	46.8	25.9	30.1	27.2	43.7
1895	29.6	19.9	43.2	26.2	29.6	27.5	39.5
1896	25.7	19.2	41.8	23.1	31.4	27.0	39.2
1897	27.2	15.7	39.9	21.5	24.3	23.1	40.1
1898	28.4	16.5	47.1	27.3	30.2	29.0	43.6
1899	30.2	23.6	48.0	30.2	33.3	27.8	41.8
1900	29.6	19.5	48.0	25.2	28.1	25.7	43.5
Average	27.9	19.4	44.0	25.6	30.0	26.8	41.6

[a] Winchester bushels.

[b] Bushels of 32 pounds.

Average value per acre of oats in the United States, 1892–1901, by States.

States and Territories.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
Maine	$14.49	$16.34	$14.74	$13.63	$12.40	$9.92	$12.24	$13.30	$14.25	$17.50
New Hampshire	14.96	14.71	15.24	12.92	13.30	13.30	12.54	13.65	12.39	15.34
Vermont	15.26	15.29	16.78	14.37	12.56	10.56	13.30	13.69	12.56	16.50
Massachusetts	14.59	14.41	13.72	12.24	12.60	10.56	11.84	12.54	13.98	17.05
Rhode Island	14.46	12.13	14.10	12.64	9.30	10.88	9.99	9.62	11.74	15.88
Connecticut	11.38	10.00	11.09	9.89	8.99	9.86	10.15	10.36	10.85	15.50
New York	10.92	7.20	8.62	8.88	8.58	8.37	8.53	10.23	8.93	10.37
New Jersey	10.54	8.37	10.79	10.29	9.52	7.50	6.08	7.92	9.18	7.52
Pennsylvania	10.08	9.38	8.47	8.56	7.43	7.61	6.99	9.57	9.33	8.50
Delaware	7.33	9.65	6.65	5.54	6.09	5.06	6.60	5.00	6.30	8.33
Maryland	7.22	7.42	8.35	7.07	5.52	6.24	5.65	6.90	7.44	7.71
Virginia	4.37	6.13	4.44	5.31	4.81	3.48	4.67	4.62	5.48	6.26
North Carolina	4.37	6.20	4.80	5.74	4.20	4.81	5.29	4.92	6.26	7.34
South Carolina	5.46	6.25	6.36	7.45	5.28	6.98	7.74	5.64	7.44	9.80
Georgia	5.56	6.92	6.83	6.67	4.92	5.88	7.97	4.32	7.35	9.92
Florida	5.39	6.49	7.20	6.63	6.36	4.77	8.32	4.50	5.65	9.43
Alabama	5.20	7.24	6.73	6.26	5.74	5.59	6.89	4.30	6.34	9.28
Mississippi	5.30	7.28	6.11	6.12	5.72	6.16	7.77	5.00	6.44	9.58
Louisiana	6.10	7.04	10.48	5.40	3.40	6.84	6.88	7.20	7.20	8.04
Texas	9.31	10.54	12.75	5.38	6.80	6.75	8.32	7.50	11.40	9.78
Arkansas	6.28	7.53	7.40	8.13	4.96	5.61	6.61	6.46	7.77	7.01
Tennessee	5.13	5.70	5.11	6.08	4.29	2.80	5.24	4.48	5.81	7.87
West Virginia	7.18	8.93	7.21	7.49	6.72	6.00	5.85	8.05	7.14	8.04
Kentucky	6.77	7.55	7.56	6.81	5.04	4.86	6.05	5.76	6.60	8.08
Ohio	9.20	8.58	9.39	6.97	5.27	6.40	7.42	9.00	9.88	12.28
Michigan	10.05	8.32	8.87	5.50	5.70	5.98	8.86	9.52	9.54	11.89
Indiana	9.01	7.70	9.69	4.58	4.64	5.74	6.72	7.36	7.52	10.87
Illinois	8.15	7.34	10.47	4.15	4.20	5.76	6.67	8.36	8.74	11.28
Wisconsin	8.76	7.45	9.87	6.08	5.95	6.46	8.66	8.28	7.36	11.35
Minnesota	7.64	6.45	8.43	5.59	4.95	4.94	7.62	7.04	6.05	10.91
Iowa	6.60	5.70	7.17	6.47	3.30	4.80	8.16	6.27	6.80	10.73
Missouri	6.00	5.85	6.76	4.99	3.06	4.18	3.91	6.00	6.30	4.82
Kansas	7.41	5.00	5.55	3.04	2.08	4.32	3.96	6.38	7.27	8.00
Nebraska	6.14	3.30	4.54	3.33	2.09	4.65	6.42	6.60	5.23	7.33
South Dakota	6.05	5.37	2.65	4.35	3.58	3.96	5.63	5.98	5.16	9.79
North Dakota	7.42	6.13	7.51	5.14	3.96	5.98	7.98	8.10	3.30	10.76
Montana	11.52	12.58	12.43	15.75	14.57	13.86	14.21	14.82	16.38	15.12
Wyoming	10.87	9.60	14.59	15.99	16.96	12.25	12.48	12.00	16.07	19.68
Colorado	9.76	9.88	6.21	9.60	8.40	10.88	14.68	11.34	14.10	16.90
New Mexico	11.37	14.89	17.50	17.96	10.80	14.56	15.91	10.56	14.45	18.96
Arizona	......	......	......	......	......	......	......	......	......	21.00
Utah	10.60	9.21	11.22	10.14	14.82	11.55	15.09	13.60	15.80	16.83
Nevada	......	......	......	......	......	......	......	......	......	30.10
Idaho	10.73	13.57	12.32	10.21	12.60	11.62	15.70	12.92	14.64	16.85
Washington	12.07	13.90	11.32	11.28	14.40	16.80	16.76	14.06	13.76	16.63
Oregon	9.81	10.55	7.48	7.78	6.93	11.20	10.80	12.30	7.59	10.71
California	11.72	9.69	15.66	10.96	13.64	8.82	16.50	14.57	11.32	13.38
Oklahoma	......	......	......	......	......	......	......	......	......	10.35
Indian Territory	......	......	......	......	......	......	......	......	......	11.50
General average	7.73	6.88	7.95	5.87	4.81	5.75	7.23	7.52	7.63	10.29

English Regulation for Sale of Butter.

Where the proportion of water in a sample of butter exceeds 16 per cent it shall be presumed for the purposes of the sale of food and drugs acts, 1875 to 1899, until the contrary is proved, that the butter is not genuine by reason of the excessive amount of water therein.

In effect May 15, 1902.

Average farm price of oats per bushel in the United States December 1, 1892–1901, by States.

States and Territories.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	45	45	44	34	31	32	34	38	38	50
New Hampshire	44	43	49	35	35	38	38	39	38	52
Vermont	43	42	51	33	31	32	35	37	36	50
Massachusetts	48	42	43	34	35	33	37	38	38	55
Rhode Island	49	43	47	39	31	31	37	37	38	54
Connecticut	45	40	43	31	31	34	36	37	35	54
New York	39	30	39	28	26	27	31	33	32	48
New Jersey	41	35	38	29	28	30	31	33	31	47
Pennsylvania	40	35	38	27	24	27	30	29	30	45
Delaware	38	38	35	29	21	23	30	25	30	45
Maryland	38	35	39	27	23	26	29	30	31	41
Virginia	39	35	37	30	26	29	29	33	37	42
North Carolina	45	44	44	38	35	37	37	41	45	51
South Carolina	52	53	53	49	48	45	45	47	48	62
Georgia	52	52	51	46	41	42	48	48	49	67
Florida	55	55	61	65	53	53	54	50	50	72
Alabama	51	51	51	42	41	43	41	43	44	64
Mississippi	50	47	47	39	44	44	42	50	46	63
Louisiana	50	44	47	36	34	38	38	40	40	60
Texas	38	42	39	26	34	27	28	30	30	60
Arkansas	40	39	40	32	31	33	29	34	35	57
Tennessee	38	31	35	27	26	28	28	32	35	45
West Virginia	41	38	39	32	28	30	30	35	34	43
Kentucky	37	34	36	26	24	27	27	32	31	41
Ohio	35	30	31	22	17	20	24	25	26	39
Michigan	35	32	34	23	19	23	27	28	26	41
Indiana	34	28	30	20	16	19	23	23	23	38
Illinois	31	27	29	17	15	18	23	22	23	40
Wisconsin	29	27	30	18	17	19	24	23	23	39
Minnesota	28	26	30	14	15	19	21	22	24	34
Iowa	26	23	28	14	12	16	24	19	20	36
Missouri	30	25	29	18	17	19	23	24	23	43
Kansas	26	27	31	17	16	18	22	22	23	43
Nebraska	23	22	36	14	11	15	20	22	24	37
South Dakota	23	25	35	17	13	18	21	23	24	34
North Dakota	28	28	29	16	18	26	26	27	32	33
Montana	40	37	31	44	31	33	35	39	42	36
Wyoming	38	40	48	39	53	35	40	40	47	48
Colorado	34	37	46	28	30	32	41	42	43	50
New Mexico	56	51	50	45	40	41	41	44	48	60
Arizona	......	......	......	......	......	......	......	......	......	60
Utah	40	33	34	30	39	33	38	40	44	51
Nevada	......	......	......	......	......	......	......	......	......	70
Idaho	37	41	32	29	30	32	36	38	40	44
Washington	35	35	31	28	40	35	40	38	40	35
Oregon	37	37	28	27	33	35	40	41	41	34
California	40	38	44	39	44	49	50	47	46	44
Oklahoma	......	......	......	......	......	......	......	......	......	50
Indian Territory	......	......	......	......	......	......	......	......	......	46
General average	31.66	29.36	32.45	19.85	18.73	21.18	25.50	24.89	25.8	30.9

Transportation rates, average for oats in sacks, in cents per 100 pounds, St. Louis to New Orleans by river.

1881	20.00	1888	15.00	1895	12.50
1882	20.00	1889	17.93	1896	14.55
1883	17.75	1890	15.66	1897	15.00
1884	14.00	1891	16.28	1898	10.00
1885	15.00	1892	16.87	1899	10.00
1886	16.00	1893	17.54	1900	10.00
1887	18.25	1894	17.14	1901	10.00

Wholesale prices of oats per bushel in leading cities of the United States, 1896–1901.

Date.	New York.		Baltimore.		Cincinnati.		Chicago.		Milwaukee.		Duluth.		Detroit.		San Francisco.	
	No. 2, mixed.		No. 2, mixed.		No. 2, mixed.		No. 2.		No. 2, white.		No. 2.		No. 2, white.		No. 1, white (per cwt.).	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High
1896.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*		
January	23¼	25	22½	23½	19¾	22	17	19½	18¼	21	15½	19	20½	23	$0.75	$0.80
February	24¾	25⅞	23½	27	21½	23	19¼	20¼	20	22	18	19	22½	23¾	.72½	.80
March	24¾	26	24½	26	21	22¾	18¼	20¼	19	21½	17½	19	22¼	23¾	.72½	.77½
April	24¾	25¾	24½	25	20¾	23	18¼	20	20	21½	17¼	19	21½	23½	.77½	.80
May	23	25½	24¼	25	20	22½	18	19⅝	19¼	21¼	17	20¾	21	23	.77½	.85
June	21½	23	20	24½	17	21¾	15¼	18½	18	20	15¼	19	18¾	22	.82½	.87½
July	20¼	22¾	20	25	17½	23	15	18½	17½	20¾	15¼	19½	19	23½	.82½	.87½
August	20½	23¾	23	25	17	21½	15¾	18½	18⅛	22	17¼	20¼	22	24¼	.82½	.87½
September	18¾	21	21	23½	15½	18½	14¾	17¼	16½	21	15¾	19¾	18½	22	.87½	.90
October	21	23¾	20½	23	17	20	17¼	19⅜	17	21½	17½	20½	20	22¼	.90	1.07½
November	22⅝	24	22	23½	19	21½	17⅛	19¾	16½	22¼	17½	19	20¼	21¼	1.07½	1.15
December	22	23½	21	23	18½	20½	16½	18¾	17¾	21½	17¾	19	19¾	21½	1.12½	1.15
1897.																
January	21½	22½	21	22	18½	20	15¾	17	18	19½	16¼	18¾	19¼	20	1.27½	1.30
February	21	21¾	21	22	16¾	19½	15⅝	16½	16½	19½	16¼	17¼	19¾	20	1.27½	1.30
March	21½	22¼	21	23½	17½	21	16	17	17½	20¾	16½	17¼	20	21½	1.20	1.30
April	22	23½	23½	24	20	21½	17	18¼	18½	22½	16½	19	21¼	22½	1.20	1.22½
May	21½	23¼	23½	26	19½	22	16⅞	18¾	20	23¼	18½	22	22	24	1.22½	1.25
June	21½	23	23	25½	19	22	17½	18½	20	23	20	21¼	21½	23½	1.20	1.25
July	21½	22½	23	24	19½	21½	17	18¾	20½	22½	19¾	21¼	21¼	24½	1.17½	1.22½
August	21¼	22¼	20	24	17	21	16¼	20⅛	20	23	18	22½	19¾	23½	1.20	1.25
September	23¼	25	21	23½	19½	21¾	18⅞	20¾	21	23½	20⅝	23	22¾	23¼	1.27½	1.30
October	22½	24½	22¾	23½	20	21¾	17¾	19¾	21	22¾	20¼	21½	22	23¼	1.17½	1.27½
November	24½	26½	23	27	20½	24½	19½	22¼	22¼	24½	21½	22¾	22	26	1.15	1.20
December	26¼	29¼	26½	28	23¼	25	21	23⅞	23	26	22	25½	24½	26	1.12½	1.17½
1898.																
January	28¼	29¼	27½	28	24	26	21½	24	23¾	25¼	23½	25	21½	26¾	1.15	1.22½
February	29	32	28	33	25½	28¾	24	27	24¾	29	24	28	26½	32¼	1.20	1.22½
March	30	32	30	32½	27½	29	24⅞	26¾	28	30	24¾	27¼	29¾	30¾	1.20	1.32½
April	29¾	35½	30	35	28	31	25	31⅞	28	33	25	32¾	30¼	32½	1.32½	1.42½
May	32½	36	33	36	29	34½	26	32	28¾	34½	27	33¼	30¼	36¼	1.40	1.42½
June	27¾	32½	27½	33	25½	28	21	26⅛	25½	29½	22½	28	27	30¼	1.35	1.37½
July	25½	28	26½	32	23½	27	20¾	26	24	29	23	25	26¼	29¾	1.30	1.37½
August	26¾	28½	24	33	21½	24¼	20¼	22½	23	28¼	20	24	24¼	27¼	1.20	1.32½
September	25½	26¾	24	26	22	25	20¼	22⅜	22¼	25½	21	23¾	23¼	25¾	1.17½	1.27½
October	25¾	29½	25½	28	23	26½	21½	25	24	27¾	23	25½	24¾	29	1.22½	1.27½
November	29	30¾	27½	32	26½	29	24¼	27¾	27	30	25	27	28½	29½	1.22½	1.27½
December	30⅝	33¾	31½	32½	28	30	26	27¾	22¾	30	26¾	30	29½	30¾	1.27½	1.32½

Wholesale prices of oats per bushel in leading cities of the United States, 1896-1901—Continued.

Date.	New York.		Baltimore.		Cincinnati.		Chicago.		Milwaukee.		Duluth.		Detroit.		San Francisco.	
	No. 2, mixed.		No. 2, mixed.		No. 2, mixed.		No. 2.		No. 2, white.		No. 2.		No. 2, white.		No. 1, white (per cwt.).	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1899.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*		
January	33	35	32	33½	28½	31	26¼	27¾	28¾	31¼	28¾	30½	30½	33	$1.30	$1.37½
February	34¼	35½	33	35	28¾	31½	26¾	28¼	29½	31½	28¼	30	32½	33	1.32	1.40
March	32	35¼	32	34	28½	31	25¼	27¾	28¾	30¾	25¾	29¼	31	32¾	1.35	1.42½
April	32½	33½	32	33	29	30½	26⅜	27¼	29½	31	27¼	28	32¼	33	1.37½	1.45
May	31	32½	29½	33	27½	29½	24	27¾	26¾	31	26½	28	30¼	32¾	1.40	1.45
June	30½	31½	29½	31	27	29	24¼	26¼	27¼	29¼	26⅛	28½	28¾	30¼	1.37½	1.42½
July	28	30½	28½	31	22	28½	19⅞	25	24	28¾	22½	26¾	25½	30	1.22½	1.27½
August	26	27½	24½	29	21½	22½	19¼	22	23	25¾	19½	23¼	23½	25½	1.22½	1.27½
September	25¾	29	25	28	22½	25½	21	23¼	22¾	26	20¼	24	23¾	28½	1.27½	1.30
October	28½	29¼	27½	29	24¾	26	22	23½	24¾	26	22¼	24¼	26	27½	1.25	1.30
November	28½	30	27½	29½	25¼	26½	22½	24	25½	26½	22½	23¾	27	28	1.25	1.30
December	28½	30	28	29½	25½	26¾	22¼	23	24¾	25½	22½	23¼	26½	27½	1.22½	1.27½
1900.																
January	29	29¾	28	29½	25¼	26½	22½	23	25	25¾	23	24	26¼	28½	1.25	1.30
February	29	29½	28¾	29½	25¼	26	22½	23¾	25½	26	24	24	27¼	28½	1.25	1.25
March	28½	29½	28	29½	25¼	26½	23	24½	25	26¾	24	24	27¼	28½	1.25	1.26¼
April	27½	29½	27¾	29¼	26	28	23	25¼	26½	29	24	24½	28¼	29	1.25	1.26¼
May	26	28	26½	28¼	24¼	26¼	21¼	23¾	24	27½	23	21½	27	28½	1.22½	1.25
June	26	29¾	26	29	24	27	21¾	26¼	24	28½	23	28	26	29¼	1.22½	1.25
July	26½	29	27	28½	25	28	21½	24¾	25¾	28½	23¾	28	28	28½	1.25	1.30
August	25½	26½	24	27	21	25	21	22⅝	24½	27	23¼	24½	24½	28	1.27½	1.30
September	24¾	25½	24½	25¾	22¼	23½	21⅛	22¼	24¾	26	22½	23¾	24¾	26	1.27½	1.27½
October	25	26	21¾	25½	23	24	21⅞	22⅝	24¾	26	23¼	24	25¼	26	1.30	1.32½
November	25½	26¾	24¾	26	23	25	21¾	22½	24¾	26¼	23¼	23¼	24	26½	1.35	1.35
December	26½	28½	26	29	24	25½	21¾	22¾	25½	26¼	23½	21¾	27	28	1.35	1.40
1901.																
January	28¼	31	28	29	25	27½	23¼	24½	....	....	25¼	26¼	28	28½	1.17½	1.45
February	30	31	28	30	26¾	28	24⅛	25½	....	....	26¼	26¾	28½	30	1.20	1.42½
March	30½	31½	29¾	31	27½	28	24¾	26½	....	....	25¼	27¼	29	29¾	1.20	1.45
April	30¾	32	30½	32	28	29	25⅛	27½	....	....	27	27¼	30	31	1.25	1.50
May	32¼	34	31	32	30	32	27⅞	31	....	....	27¼	29¼	30½	32½	1.30	1.45
June	32	33	31½	32½	29½	30½	27	28¾	....	....	27¼	28¼	30	31½	1.40	1.55
July	33½	41½	31½	42	31½	42	27⅛	39	....	....	27¼	36¼	31½	40½	1.15	1.40
August	38	40½	37¼	42½	37	38	33½	37½	....	....	34⅞	37½	54½	60½	1.10	1.35
September	38	39½	37½	38½	36	38	33⅝	36¾	....	....	35⅛	37½	36¼	39½	1.10	1.30
October	38	42	38	41½	38	39	34½	37¾	....	....	35¼	37⅛	38½	40½	1.02½	1.30
November	42½	49	41	49	40	46	37⅛	44⅛	....	....	36⅞	43¼	41½	48½	1.10	1.30
December	49	52	48½	53	47	50¼	42	48½	....	....	42¾	46⅞	48½	51	1.20	1.42½

Monthly average prices of oats in Chicago.[a]

[Cents per bushel.]

Month.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
January	20 1/2	43 3/4	29 1/4	31	28 1/4	28 7/8	18 1/4	16 3/8	22 1/4	27	22 3/4	23 7/8
February	20 1/4	46 1/8	29 3/4	30 3/4	28 3/4	28 1/4	19 15/16	16 1/8	25 1/2	27 1/2	23 1/8	21 13/16
March	21 1/4	50 5/8	28 1/2	29 15/16	30 1/16	29 3/8	19 1/4	16 1/2	25 13/16	26 1/2	23 9/16	25 5/8
April	23 5/8	53 1/4	29 1/8	27 15/16	32 1/8	29 1/16	19 1/8	17 1/8	28 7/16	26 13/16	24 1/8	26 1/2
May	27 7/16	49 5/8	31	30 1/2	34 1/2	29 7/16	18 13/16	17 13/16	29	25 7/8	27 1/2	29 7/16
June	28 1/8	39 1/2	31 3/4	29 3/8	42	28 3/16	16 7/8	18 1/8	23 3/4	25 1/4	24	27 7/8
July	30 13/16	33 1/8	31 7/8	26 3/16	38 3/16	23 7/8	16 3/4	17 9/16	23 3/8	22 7/16	23 1/8	33 1/4
August	37 1/8	29 1/2	32 3/4	23 1/2	30 7/8	20 7/8	17 1/8	18 3/16	21 3/8	20 5/8	21 13/16	35 1/8
September	37 1/4	28 1/4	33 1/8	26 5/16	29 5/16	19 1/4	16	19 13/16	21 5/16	22 1/8	21 11/16	35 3/16
October	41 3/8	28 3/16	30 1/4	27 1/8	28 1/2	18 1/4	18 5/16	18 3/4	23 1/4	22 3/4	22	36 1/8
November	43 1/8	32 1/4	31 1/4	28 1/4	29 1/8	18 1/2	18 5/8	20 7/8	26	23 1/4	22 1/8	40 5/8
December	41 7/8	32 3/16	30 3/4	28 1/8	29 1/2	17 5/16	17 5/8	22 7/16	26 7/8	22 5/8	22 1/4	45 1/8
Yearly average	31 1/16	38 7/8	30 13/16	28 1/4	31 3/4	24 1/4	18 1/16	18 1/4	24 3/4	24 3/8	23 1/8	32

[a] This table exhibits average cash prices for the past twelve years. The monthly prices are the means between the lowest and highest prices for each month, and the yearly prices are the averages of the monthly averages.

BARLEY.

The wholesale prices of barley were well maintained with other cereals during the year 1901, and ranged relatively higher than in former years noted in accompanying table:

Barley crops of the countries named, 1897–1901.

Countries.	1897.	1898.	1899.	1900.	1901.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States	66,685,000	55,792,000	73,382,000	58,926,000	109,933,000
Ontario	12,401,000	13,063,000	15,298,000	17,443,000	17,289,000
Manitoba	3,284,000	4,413,000	5,549,000	3,032,000	6,742,000
Rest of Canada	2,400,000	2,900,000	2,950,000	2,500,000	3,500,000
Total Canada	18,085,000	20,376,000	23,797,000	22,975,000	27,531,000
Mexico	8,841,000	13,401,000	10,735,000	10,000,000	9,000,000
Total North America	93,614,000	89,569,000	107,914,000	91,901,000	146,464,000
Great Britain	68,920,000	70,197,000	68,850,000	64,278,000	63,033,000
Ireland	5,982,000	6,889,000	7,024,000	6,485,000	6,803,000
Total United Kingdom	74,902,000	77,086,000	75,874,000	70,763,000	69,836,000
Sweden	14,303,000	11,805,000	11,691,000	14,786,000	13,368,000
Denmark	19,172,000	21,868,000	21,691,000	22,826,000	18,000,000
Netherlands	3,736,000	3,822,000	3,971,000	3,500,000	3,700,000
Belgium	3,501,000	3,860,000	3,902,000	4,754,000	4,555,000
France	41,157,000	46,878,000	45,306,000	40,847,000	38,884,000
Spain	47,064,000	57,668,000	53,428,000	55,000,000	55,000,000
Italy	7,700,000	8,900,000	8,000,000	7,000,000	8,000,000
Germany	119,580,000	132,019,000	137,048,000	137,889,000	152,537,000
Austria	50,926,000	63,486,000	73,226,000	61,480,000	67,091,000
Hungary	42,025,000	57,334,000	61,587,000	53,879,000	48,611,000
Croatia-Slavonia	2,079,000	3,540,000	2,735,000	3,132,000	2,613,000
Total Austria-Hungary	95,030,000	124,360,000	137,548,000	118,491,000	118,315,000
Roumania	21,225,000	29,656,000	4,543,000	14,618,000	24,222,000
Bulgaria	11,000,000	12,204,000	6,650,000	10,000,000	12,000,000
Russia proper	203,363,000	254,702,000	179,850,000	187,230,000	189,435,000
Poland	15,967,000	19,480,000	20,090,000	18,415,000	20,640,000
North Caucasus	11,120,000	25,107,000	18,144,000	27,105,000	25,685,000
Total Russia in Europe	230,450,000	299,289,000	218,084,000	232,750,000	235,760,000
Total Europe	688,820,000	832,415,000	727,739,000	733,224,000	754,177,000

Barley crops of the countries named, 1897–1901—Continued.

Countries.	1897.	1898.	1899.	1900.	1901.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Siberia	6,119,000	4,904,000	5,955,000	2,969,000	2,003,000
Central Asia	2,081,000	2,728,000	2,870,000	1,262,000	2,154,000
Total Russia in Asia	8,200,000	7,632,000	8,825,000	4,231,000	4,157,000
Japan	41,099,000	45,629,000	43,037,000	44,328,000	44,000,000
Total Asia	49,299,000	53,261,000	51,862,000	48,559,000	48,157,000
Algeria	25,055,000	41,467,000	33,088,000	35,000,000	35,000,000
Tunis	5,000,000	11,000,000	7,000,000	7,000,000	8,000,000
Cape Colony	793,000	937,000	857,000	800,000	800,000
Total Africa	30,848,000	53,404,000	40,945,000	42,800,000	43,800,000
West Australia	13,000	24,000	30,000	58,000	30,000
South Australia	111,000	167,000	241,000	195,000	218,000
Queensland	20,000	52,000	36,000	122,000	119,000
New South Wales	114,000	103,000	66,000	138,000	117,000
Victoria	841,000	782,000	1,148,000	1,512,000	1,254,000
Tasmania	77,000	72,000	190,000	70,000	70,000
New Zealand	848,000	732,000	1,731,000	1,635,000	1,060,000
Total Australasia	2,024,000	1,932,000	3,442,000	3,730,000	2,868,000
Grand total	864,605,000	1,030,581,000	931,902,000	920,214,000	995,466,000

Visible supply of barley in the United States first of each month for ten years.[a]

Month.	1892–1893.	1893–1894.	1894–1895.	1895–1896.	1896–1897.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	610,000	549,000	383,000	160,000	805,000
August	665,000	628,000	200,000	48,000	771,000
September	581,000	464,000	774,000	121,000	790,000
October	1,567,000	1,002,000	2,401,000	1,956,000	2,292,000
November	3,444,000	3,242,000	4,433,000	3,645,000	6,032,000
December	4,103,000	4,324,000	4,455,000	5,674,000	5,500,000
January	3,264,000	3,098,000	3,781,000	4,017,000	4,501,000
February	3,088,000	2,495,000	2,481,000	2,970,000	4,183,000
March	2,476,000	1,662,000	1,974,000	2,081,000	4,124,000
April	1,768,000	1,087,000	1,274,000	1,298,000	3,514,000
May	1,161,000	620,000	565,000	1,253,000	2,816,000
June	670,000	399,000	162,000	957,000	1,819,000

Month.	1897–1898.	1898–1899.	1899–1900.	1900–1901.	1901–1902.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	1,574,000	587,000	1,059,000	1,038,000	528,000
August	1,051,000	584,000	694,000	702,000	335,000
September	1,578,000	548,000	1,055,000	1,158,000	956,000
October	2,630,000	2,125,000	1,739,000	2,779,000	3,610,000
November	4,267,000	3,777,000	3,925,000	5,396,000	4,813,000
December	6,318,000	4,406,000	4,695,000	6,053,000	5,416,000
January	5,115,000	4,372,000	3,122,000	5,395,000	4,580,000
February	3,455,000	4,017,000	2,303,000	4,331,000	5,244,000
March	2,571,000	3,067,000	2,138,000	3,903,000	5,065,000
April	1,492,000	2,626,000	1,712,000	2,879,000	4,075,000
May	1,159,000	1,913,000	1,720,000	1,761,000	2,146,000
June	815,000	1,555,000	1,267,000	1,351,000	....

[a] These figures represent stocks available at 62 of the principal points of accumulation east of the Rocky Mountains, stocks in Manitoba elevators, and stocks afloat on lakes and canals.

Condition of barley crop of United States, monthly, 1886–1901.

Year.	June.	July.	August.	September.	Year.	June.	July.	August.	September.
1886	100.0	89.7	90.9	92.7	1894	82.2	76.8	69.8	71.5
1887	87.0	82.8	86.2	83.0	1895	90.3	91.9	87.2	87.6
1888	88.8	91.0	89.4	86.9	1896	98.0	88.1	82.9	83.1
1889	95.6	91.9	90.6	88.9	1897	87.4	88.5	87.5	86.4
1890	86.4	88.3	82.8	78.6	1898	78.8	85.7	79.3	79.2
1891	90.3	90.9	93.8	94.3	1899	91.4	92.0	93.6	86.7
1892	92.1	92.0	91.1	87.4	1900	86.2	76.3	71.6	70.7
1893	88.3	88.8	84.6	83.8	1901	98.8	91.3	86.9	85.8

Acreage, production, value, prices, exports, etc., of barley of the United States, 1866–1901.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1.	Farm value, Dec. 1.	Chicago cash price per bushel, No. 2. December. Low.	December. High.	May of following year. Low.	May of following year. High.	Domestic exports, fiscal years beginning July 1.	Imports, fiscal years beginning July 1.
	Acres.	Bush.	Bushels.	Cts.	Dollars.	Cts.	Cts.	Cts.	Cts.	Bushels.	Bushels.
1866	492,532	22.9	11,283,807	70.2	7,916,342	59	70	85	100	....	3,247,250
1867	1,131,217	22.7	25,727,000	70.1	18,027,746	150	180	227	250	9,810	3,783,966
1868	937,498	24.4	22,896,100	109.0	24,948,127	140	170	149	175	59,077	5,069,880
1869	1,025,795	27.9	28,652,200	70.8	20,298,164	74	85	50	62	255,490	6,727,597
1870	1,108,924	23.7	26,295,400	79.1	20,792,213	68	80	72	95	340,093	4,866,700
1871	1,113,735	24.0	26,718,500	75.8	20,264,015	55½	64	55	71	86,891	5,565,591
1872	1,397,082	19.2	26,846,400	68.6	18,415,839	60	70	71	85	482,410	4,244,751
1873	1,387,106	23.1	32,044,491	86.7	27,794,229	132	158	130	155	320,399	4,891,189
1874	1,580,626	20.6	32,552,500	86.0	27,997,824	120	129½	115	137	91,118	6,255,063
1875	1,789,902	20.6	36,908,600	74.1	27,367,522	81	88	62½	72½	317,781	10,285,957
1876	1,766,511	21.9	38,710,500	63.0	24,402,691	63¾	68½	80	85	1,186,129	6,702,965
1877	1,614,654	21.3	34,441,400	62.8	21,629,130	56¼	64	46½	52½	3,921,501	6,764,228
1878	1,790,400	23.6	42,245,630	57.9	24,454,301	91	100	64	73	715,536	5,720,979
1879	1,680,700	24.0	40,283,100	58.9	23,714,444	86	92	75	80	1,128,923	7,135,258
1880	1,843,329	24.5	45,165,346	66.6	30,090,742	100	120	95	105	885,246	9,528,616
1881	1,967,510	20.9	41,161,330	82.3	33,862,513	101	107	100	100	205,930	12,182,722
1882	2,272,103	21.5	48,953,926	62.9	30,768,015	79	82	80	80	433,005	10,050,687
1883	2,379,009	21.1	50,136,097	58.7	29,420,423	62	67	65	74	724,955	8,596,122
1884	2,608,818	23.5	61,203,000	48.7	29,779,170	53	58	65	65	629,130	9,986,507
1885	2,729,359	21.4	58,360,000	56.3	32,867,696	62	65	58	60	252,183	10,197,115
1886	2,652,957	22.4	59,428,000	53.6	31,840,510	51	54	57	57	1,305,300	10,355,594
1887	2,901,958	19.6	56,812,000	51.9	29,464,390	80	80	69	77	550,884	10,831,461
1888	2,996,382	21.3	63,884,000	59.0	37,672,032	......	......	......	......	1,440,321	11,368,414
1889	3,220,874	24.3	78,332,976	41.6	32,614,271	58	58	......	......	1,408,311	11,332,545
1890	3,135,302	21.4	67,168,344	62.7	42,140,502	......	......	......	......	973,062	5,078,733
1891	3,352,579	25.9	86,839,153	52.4	45,470,342	......	......	......	......	2,800,075	3,146,328
1892	3,400,361	23.6	80,096,762	47.5	38,026,062	65	67	65	65	3,035,267	1,970,129
1893	3,220,371	21.7	69,869,495	41.1	28,729,386	52	54	55	60	5,219,405	791,061
1894	3,170,602	19.4	61,400,465	44.2	27,134,127	53½	55½	51	52	1,563,754	2,116,816
1895	3,299,973	26.4	87,072,744	33.7	29,312,413	33	40	25	36	7,680,331	837,384
1896	2,950,539	23.6	69,695,223	32.3	22,491,241	[a]22	37	[a]24½	35	20,030,301	1,271,787
1897	2,719,116	24.5	66,685,127	37.7	25,142,139	[a]25½	42	[a]36	53	11,237,077	124,804
1898	2,583,125	21.6	55,792,257	41.3	23,064,359	[a]40	50½	[a]36	42	2,267,400	110,475
1899	2,878,229	25.5	73,381,563	40.3	29,594,254	[a]35	45	[a]36	44	23,661,662	189,757
1900	2,894,282	20.4	58,925,833	40.8	24,075,271	[a]37	61	[a]37	57	6,293,207	171,002
1901	4,295,744	25.6	109,932,924	45.2	49,705,163	[a]56	63	......	......	....	....

[a] Chicago prices from 1895 are for No. 3 grade.

Acreage, production, and value of barley in the United States in 1901, by States.

States and Territories.	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Average value per acre.	Farm value, Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*	*Dollars.*
Maine	8,658	27.5	238,095	67	18.43	159,524
New Hampshire	1,852	21.5	39,818	80	17.20	31,854
Vermont	12,577	29.6	372,279	66	19.54	245,704
New York	120,272	14.0	1,683,808	56	7.84	942,932
Pennsylvania	9,057	17.2	155,780	59	10.15	91,910
Maryland	1,545	18.0	27,810	52	9.36	14,461
Virginia	2,824	24.9	70,318	47	11.70	33,049
Texas	4,870	13.5	65,745	88	11.88	57,856
Tennessee	1,541	16.8	25,889	70	11.76	18,122
Kentucky	996	19.4	19,322	71	13.77	13,719
Ohio	30,780	24.9	766,422	51	12.70	390,875
Michigan	40,293	22.8	918,680	54	12.31	496,087
Indiana	12,353	25.4	313,766	51	12.95	160,021
Illinois	21,022	24.5	515,039	53	12.99	272,971
Wisconsin	493,355	27.2	13,419,256	51	13.87	6,843,821
Minnesota	840,334	25.8	21,680,617	45	11.61	9,756,278
Iowa	529,380	23.6	12,493,368	47	11.09	5,871,883
Missouri	1,637	16.5	27,010	55	9.08	14,856
Kansas	137,563	15.9	2,187,252	45	7.15	984,263
Nebraska	74,293	16.0	1,188,688	41	6.56	487,362
South Dakota	291,186	22.4	6,522,566	42	9.41	2,739,478
North Dakota	257,409	28.2	7,258,934	40	11.28	2,903,574
Montana	16,398	39.0	639,522	57	22.23	364,528
Wyoming	1,249	32.5	40,592	65	21.12	26,385
Colorado	20,811	28.7	597,276	63	18.08	376,284
New Mexico	1,108	31.7	35,124	65	20.61	22,831
Arizona	13,280	28.7	381,136	68	19.52	259,172
Utah	8,552	35.0	299,320	53	18.55	158,640
Nevada	6,828	33.0	225,324	70	23.10	157,727
Idaho	34,301	40.2	1,378,900	53	21.31	730,817
Washington	133,405	43.5	5,803,118	41	17.83	2,379,278
Oregon	61,707	30.6	1,888,234	49	14.99	925,235
California	1,089,785	26.0	28,334,410	41	10.66	11,617,108
Oklahoma	14,523	22.0	319,506	49	10.78	156,558
United States	4,295,744	25.6	109,932,924	45.2	11.57	49,705,163

Average yield per acre of barley in the United States, 1892–1901, by States.

States and Territories.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	22.3	26.1	26.1	32.4	30.6	25.0	27.0	29.0	27.4	27.5
New Hampshire	23.5	25.3	24.4	25.6	29.3	22.5	23.5	25.0	22.7	21.5
Vermont	26.0	27.5	27.9	33.2	33.0	28.5	30.0	31.0	29.1	29.6
Massachusetts	22.5	25.3	21.7	22.5	30.0	34.5	24.5	30.0	25.8	......
Rhode Island	21.5	25.2	30.0	23.5	29.0	28.0	28.0	29.0	28.0	......
New York	22.2	20.3	17.5	22.9	23.2	25.0	25.2	24.0	22.0	14.0
Pennsylvania	21.7	19.0	16.6	20.2	17.2	24.5	19.4	21.0	19.0	17.2
Maryland	......	......	......	......	......	......	......	......	......	18.0
Virginia	......	......	......	......	......	......	......	......	......	24.9
Texas	16.5	14.5	15.3	21.6	12.0	25.0	20.0	18.0	24.6	13.5
Tennessee	19.5	15.1	13.8	23.1	14.0	18.0	18.0	11.0	14.7	16.8
Kentucky	22.3	17.0	28.7	33.3	14.8	20.0	16.0	21.0	28.6	19.4
Ohio	23.5	22.7	28.5	28.2	20.2	28.5	28.7	28.0	27.0	24.9
Michigan	23.4	16.4	20.6	18.1	22.3	21.5	25.2	24.0	23.9	22.8
Indiana	28.0	19.9	20.7	15.0	20.3	19.0	23.4	25.0	24.6	25.4
Illinois	17.9	23.2	23.5	20.0	23.7	25.0	27.3	29.0	25.6	24.5
Wisconsin	25.5	24.0	28.6	29.3	27.4	28.0	29.1	30.0	25.5	27.2
Minnesota	24.9	22.1	23.5	36.0	27.2	25.5	28.4	25.0	22.4	25.8
Iowa	21.1	22.6	15.5	28.0	26.3	24.0	26.0	26.0	26.4	23.6
Missouri	29.1	20.0	14.0	15.3	17.5	19.0	20.0	18.0	20.8	16.5
Kansas	25.0	8.1	8.8	14.4	4.6	17.5	28.0	17.0	21.5	15.9
Nebraska	22.2	12.0	5.7	28.4	19.9	22.0	27.1	26.0	17.6	16.0
South Dakota	23.3	15.4	14.7	19.5	28.5	20.0	23.0	23.0	14.3	22.4
North Dakota	24.3	15.2	20.1	30.4	16.1	22.5	26.4	24.0	8.2	28.2
Montana	32.5	30.1	22.5	25.0	25.0	38.0	36.0	35.0	38.8	39.0
Wyoming	......	......	......	......	......	......	......	......	......	32.5
Colorado	24.0	28.3	27.8	31.3	20.0	28.0	30.5	28.0	24.8	28.7
New Mexico	19.6	21.6	27.0	28.0	19.0	32.5	33.8	32.0	29.0	31.7
Arizona	......	......	......	......	......	......	......	......	......	28.7
Utah	20.3	37.6	33.0	30.0	27.1	31.0	37.0	33.0	36.5	35.0
Nevada	......	......	......	......	......	......	......	......	......	33.0
Idaho	26.0	30.0	32.6	24.5	15.3	35.0	35.0	35.0	32.8	40.2
Washington	25.3	40.1	33.7	37.3	26.0	45.0	39.8	35.0	33.4	43.5
Oregon	23.3	26.1	38.6	22.1	21.8	32.5	29.1	28.0	28.9	30.6
California	24.0	22.5	15.2	20.3	21.6	23.0	10.5	26.0	16.7	26.0
Oklahoma	......	......	......	......	......	......	......	......	......	22.0
General average	23.70	21.70	19.37	26.39	23.62	24.52	21.60	25.50	20.4	25.6

Average yield of barley in certain countries, in bushels per acre, 1894–1900.

Year.	United States.	Russia.	Germany.	Austria.	Hungary.	France.	United Kingdom.
	(a)	(b)	(b)	(b)	(b)	(a)	(a)
1894	19.4	15.3	33.0	22.3	22.7	22.0	35.9
1895	26.4	13.7	31.2	20.9	21.4	21.9	33.1
1896	23.6	12.8	30.7	19.3	24.0	21.8	35.2
1897	24.5	11.8	29.0	17.6	17.6	19.4	33.9
1898	21.6	14.9	32.2	22.0	23.6	23.3	37.4
1899	25.5	11.1	33.8	24.9	24.0	22.7	35.7
1900	20.4	11.4	33.4	20.2	20.9	21.8	32.7
Average	23.1	13.0	31.9	21.0	22.0	21.8	34.8

[a] Winchester bushels. [b] Bushels of 48 pounds.

Average value per acre of barley in the United States, 1892–1901, by States.

States and Territories.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
Maine	$15.16	$17.49	$17.23	$16.85	$13.16	$13.75	$15.12	$17.11	$16.99	$18.43
New Hampshire	17.39	17.71	15.37	14.34	15.53	13.50	13.63	16.25	15.21	17.20
Vermont	17.16	16.50	16.74	15.60	13.53	13.11	14.10	16.12	15.13	19.54
Massachusetts	16.87	22.77	13.67	14.63	17.40	22.77	16.17	20.40	17.80	......
Rhode Island	17.63	21.92	21.60	17.63	17.40	15.12	17.08	20.30	21.56	......
New York	16.65	12.18	9.80	18.55	9.05	10.50	12.10	12.00	11.22	7.84
Pennsylvania	12.37	9.50	7.97	8.28	6.88	9.55	8.54	10.29	9.50	10.15
Maryland	......	......	......	......	......	......	......	......	......	9.36
Virginia	......	......	......	......	......	......	......	......	......	11.70
Texas	10.73	8.99	8.41	11.66	6.00	10.75	10.00	11.88	17.71	11.88
Tennessee	12.87	8.31	7.73	11.55	6.30	10.62	10.08	7.01	9.11	11.76
Kentucky	8.47	8.67	13.49	12.65	5.92	8.00	6.40	9.03	15.73	13.77
Ohio	13.39	10.67	13.68	11.56	7.68	11.69	12.63	12.60	11.61	12.70
Michigan	14.04	8.04	10.30	7.78	9.37	8.60	11.09	11.52	11.23	12.31
Indiana	14.56	8.95	9.32	6.00	6.70	8.36	10.30	11.25	11.56	12.95
Illinois	8.77	9.28	11.28	9.00	7.35	9.50	10.65	13.63	12.03	12.99
Wisconsin	12.75	10.32	12.87	9.96	7.40	8.96	11.64	12.00	11.22	13.87
Minnesota	12.81	7.96	9.63	8.64	5.44	6.12	9.37	7.75	8.51	11.61
Iowa	8.44	7.46	6.51	6.44	5.52	5.76	8.84	8.06	9.77	11.09
Missouri	12.22	8.00	7.14	7.34	4.88	7.60	7.20	7.56	9.36	9.08
Kansas	8.75	3.81	4.31	3.31	1.01	4.88	7.56	4.59	7.10	7.15
Nebraska	7.33	3.72	2.45	6.82	3.78	5.28	6.78	7.80	5.81	6.56
South Dakota	8.16	5.08	4.72	3.71	5.42	4.40	6.21	6.67	4.43	9.41
North Dakota	8.02	4.71	7.24	6.08	3.38	6.07	7.66	7.92	2.87	11.28
Montana	21.45	15.05	9.00	14.75	13.75	19.00	20.52	17.85	18.62	22.23
Wyoming	......	......	......	......	......	......	......	......	......	21.12
Colorado	12.96	14.15	16.04	18.78	9.20	14.28	14.03	15.40	12.40	18.08
New Mexico	12.74	12.53	18.90	19.04	12.35	17.88	18.59	19.52	17.98	20.61
Arizona	......	......	......	......	......	......	......	......	......	19.52
Utah	10.56	16.92	15.18	11.70	11.38	13.95	17.39	17.16	20.07	18.55
Nevada	......	......	......	......	......	......	......	......	......	23.10
Idaho	8.58	15.90	15.32	10.29	8.37	14.70	16.80	16.10	16.40	21.31
Washington	11.39	15.64	10.78	14.17	10.40	19.35	17.91	15.40	13.03	17.83
Oregon	10.72	10.44	12.74	8.84	9.81	14.63	14.26	14.00	12.14	14.99
California	11.28	9.45	6.84	8.12	10.37	12.42	6.82	13.00	7.18	10.66
Oklahoma	......	......	......	......	......	......	......	......	......	10.78
General average	11.18	8.92	8.56	8.88	7.62	9.25	8.93	10.28	8.32	11.57

Average farm price per bushel of barley in the United States December 1, 1892–1901, by States.

States and Territories.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	68	67	66	52	43	55	56	59	62	67
New Hampshire	74	70	63	56	53	60	58	65	67	80
Vermont	66	60	60	47	41	46	47	52	52	66
Massachusetts	75	90	63	65	58	66	66	68	69	......
Rhode Island	82	87	72	75	60	54	61	70	77	......
New York	75	60	56	81	39	42	48	50	51	56
Pennsylvania	57	50	48	41	40	39	44	49	50	59
Maryland	......	......	......	......	......	......	......	......	......	52
Virginia	......	......	......	......	......	......	......	......	......	47
Texas	65	62	55	54	50	43	50	66	72	88
Tennessee	66	55	56	50	45	59	56	64	62	70
Kentucky	38	51	47	38	40	40	40	43	55	71
Ohio	57	47	48	41	38	41	44	45	43	51
Michigan	60	49	50	43	42	40	44	48	47	54
Indiana	52	45	45	40	33	44	44	45	47	51
Illinois	49	40	48	45	31	38	39	47	47	53
Wisconsin	50	43	45	34	27	32	40	40	44	51
Minnesota	42	36	41	24	20	24	33	31	38	45
Iowa	40	33	42	23	21	24	34	31	37	47

Average farm price per bushel of barley in the United States December 1, 1892–1901, States—Continued.

States and Territories.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Missouri	42	40	51	48	25	40	36	42	45	55
Kansas	35	47	49	23	22	25	27	27	33	45
Nebraska	33	31	43	24	19	24	25	30	33	41
South Dakota	35	33	35	19	19	22	27	29	31	42
North Dakota	33	31	36	20	21	27	29	33	35	40
Montana	66	50	40	59	55	50	57	51	48	52
Wyoming	......	......	......	......	......	......	......	......	......	65
Colorado	54	50	58	60	46	51	46	55	50	63
New Mexico	65	58	70	68	65	55	55	61	62	65
Arizona	......	......	......	......	......	......	......	......	......	68
Utah	52	45	46	39	42	45	47	52	55	58
Nevada	......	......	......	......	......	......	......	......	......	70
Idaho	33	53	47	42	22	42	48	46	50	53
Washington	45	39	32	38	40	43	45	44	39	41
Oregon	46	40	33	40	45	45	49	50	42	49
California	47	42	45	40	48	54	65	50	43	41
Oklahoma	......	......	......	......	......	......	......	......	......	49
General average	47.20	41.12	44.19	33.66	32.27	37.70	41.34	40.33	40.80	45.21

Transportation rates, average for barley in sacks, in cents per 100 pounds, St. Louis to New Orleans by river.

1881	20.00	1888	15.00	1895	12.50
1882	20.00	1889	17.93	1896	14.55
1883	17	1890	15.66	1897	15.00
1884	14.00	1891	16.28	1898	10.00
1885	15.00	1892	16.87	1899	10.00
1886	16.00	1893	17.54	1900	10.00
1887	18.25	1894	17.14	1901	10.00

Wholesale prices of barley per bushel in leading cities of the United States, 1897–1901.

Date.	New York.		Cincinnati.		Chicago.		San Francisco.	
	Western.		Extra No. 3, spring.		No. 3.		No. 1, brewing, per cwt.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1897.								
January	$0.33½	$0.35½	$0.30	$0.37	$0.23½	$0.35	$0.95	$1.00
February	.31¼	.33¾	.30	.35	.22½	.35	.90	.92½
March	.31	.33	.30	.35	.22½	.33	.82½	.92½
April	.31	.33	.30	.35	.22	.34	.82½	.87½
May	.31	.32½	.30	.35	.24½	.35	.85	.87½
June	.30	.32	.30	.35	.26	.34	.85	.90
July	.31¾	.33½	.30	.35	.25½	.34	.87½	1.00
August	.34½	.47	.30	.35	.25	.46	1.02½	1.12½
September	.39	.47	.30	.45	.26	.47	1.07½	1.10
October	.50	.53	.36	.41	.25	.48	1.02½	1.10
November	.42½	.49	.36	.41	.25½	.45	1.02½	1.07½
December	.43½	.49	.36	.41	.25½	.42	1.02½	1.05
1898.								
January	.50	.52	.32	.36	.26½	.42	.92½	.97½
February	.52	.53	.32	.42	.27½	.42	.97½	1.07½
March	.52	54	.36	.42	.32	.43	1.07½	1.20
April	.54	.55	.36	.42	.34	.52	1.22½	1.42½
May	.55	.61	.36	.53	.36	.53	1.25	1.35
June	.48	.60	......	......	.30	.46	1.15	1.22½
July	.46	.48	......	......	.30	.38	1.17½	1.22½
August	.46	.48	......	......	.30	.47½	1.15	1.20
September	.46	.48	.42	.42	.32½	.45	1.15	1.22½
October	.48	.50	.42	.45	.32	.49	1.20	1.22½
November	.52	.56	.47	.54	.36	.50	1.20	1.27½
December	.57	.60	.47	.54	.40	.50½	1.22½	1.30
1899.								
January	.57	.62	.50	.56	.41	.54	1.40	1.47½
February	.60	.62	.50	.56	.41	.53	1.40	1.42½
March	.53	.60	.50	.53	.38	.51	1.35	1.42½
April	.54	.55	.50	.53	.39	.48	1.20	1.37½
May	.50	.54	.50	.53	.36	.42	1.17½	1.25
June	.46	.52	......	......	.35½	.42	1.02½	1.22½
July	.48	.50	......	......	.34	.42	1.05	1.15
August	.46	.50	......	......	.34	.43	.97½	1.05
September	.50	.52	.44	.50	.36	.47	.95	1.01½

Wholesale prices of barley per bushel in leading cities of the United States, 1897-1901—Continued.

Date.	New York. Western. Low.	New York. Western. High.	Cincinnati. Extra No. 3, spring. Low.	Cincinnati. Extra No. 3, spring. High.	Chicago. No. 3. Low.	Chicago. No. 3. High.	San Francisco. No. 1, brewing, per cwt. Low.	San Francisco. No. 1, brewing, per cwt. High.
1899.								
October	$0.50	$0.54	$0.50	$0.50	$0.37	$0.46	$1.00	$1.03¾
November	.46	.50	.48	.50	.34	.45	.96¼	1.01¼
December	.49	.52	.45	.50	.35	.45	.85	.97½
1900.								
January	.49	.50	.44¾	.49	.34	.48	.72½	.75
February	.50	.51	.47	.49	.34	.46	.72½	.75
March	.52	.50	.47	.49	.36	.44	.72½	.73¾
April	.52	.52½	.47	.49	.36	.45	.72½	.72½
May	.52	.52	.47	.49	.36	.44	.67½	.72½
June	.51	.55	....	....	.36	.48	.67½	.70
July	.54	.54	....	....	.36	.48	.70	.71¼
August	.52	.57	....	....	.33	.50	.72½	.72½
September	.54	.58	.46	.55	.38	.57	.72½	.72½
October	.60	.62	.56	.64	.36	.59	.71¼	.72½
November	.62	.65	.56	.66	.36	.62	.72½	.75
December	.64	.66	.58	.66	.37	.61	.72½	.75
1901.								
January	.65	.68	.68	.75	.36	.63	.75	.80
February	.65	.70	.70	.75	.37	.61	.73¾	.81¼
March	.59	.65	.66	.75	.37	.59	.75	.82½
April	.61	.63	.64	.72	.38	.58	.78¾	.85
May	.63	.63	.62	.70	.37	.57	.77½	.81¼
June	Nominal.		.62	.65	.40	.54	.75	.80
July	.57	.60	....	....	.40	.65	.77½	.82½
August	.64	.67	....	....	.48	.65	.80	.83¾
September	.65	.67	.67	.69	.50	.62	.80	.82½
October	.60	.68	.64	.69	.51	.60	.77½	.82½
November	.62	.69	.64	.70	.51	.63	.76¼	.82½
December	.70	.72	.69	.71	.56	.63	.78¾	.85

RYE.

Prices of rye were well maintained during the year 1901, and the yearly average price at Chicago of 53¼ cents exceeded that of 1900 by 1¼ cents and was the highest in several years excepting 1899, when the average was 55$\frac{1}{16}$ cents. The wholesale cash price in Chicago at the commencement of the year ranged at 47½ to 49¾ cents, sold up in May to 54 cents, back in June to 46¾ to 53 cents. Started in in July at 47 cents, advanced to 57 cents, and in December up to 65¾ cents, the high range of the year.

Rye crops of the countries named, 1897-1901.

Countries.	1897.	1898.	1899.	1900.	1901.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States	27,363,000	25,658,000	23,962,000	23,996,000	30,345,000
Ontario	3,489,000	2,757,000	2,357,000	2,432,000	2,628,000
Manitoba	50,000	66,000	66,000	27,000	64,000
Rest of Canada	470,000	420,000	400,000	375,000	800,000
Total Canada	4,009,000	3,243,000	2,823,000	2,834,000	3,492,000
Total North America	31,372,000	28,901,000	26,785,000	26,830,000	33,837,000
Great Britain	1,709,000	1,782,000	....	....	....
Ireland	283,000	316,000	....	....	....
Total United Kingdom	1,992,000	2,098,000	2,000,000	2,000,000	2,000,000
Sweden	23,599,000	21,469,000	21,436,000	26,008,000	22,646,000
Denmark	18,116,000	16,132,000	18,359,000	19,958,000	16,200,000
Netherlands	11,930,000	13,664,000	12,967,000	12,000,000	13,000,000
Belgium	19,258,000	18,991,000	16,544,000	19,854,000	21,654,000
France	48,139,000	66,755,000	66,904,000	59,277,000	62,366,000
Spain	18,672,000	19,324,000	20,519,000	19,000,000	23,000,000
Italy	4,000,000	4,000,000	2,700,000	4,000,000	4,000,000
Germany	321,659,000	355,581,000	341,551,000	336,624,000	321,350,000

Rye crops of the countries named, 1897–1901—Continued.

Countries.	1897.	1898.	1899.	1900.	1901.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Austria	63,052,000	79,687,000	85,268,000	54,792,000	75,514,000
Hungary	33,955,000	42,797,000	47,204,000	39,900,000	41,700,000
Croatia-Slavonia	2,265,000	3,497,000	2,668,000	2,286,000	3,307,000
Total Austria-Hungary	99,272,000	125,981,000	135,140,000	96,978,000	120,521,000
Roumania	6,794,000	7,629,000	1,988,000	5,990,000	9,573,000
Bulgaria	10,000,000	5,437,000	4,655,000	7,000,000	8,000,000
Russia proper	567,466,000	636,467,000	805,230,000	828,816,000	680,205,000
Poland	54,228,000	72,029,000	67,580,000	67,621,000	50,781,000
North Caucasus	3,758,000	5,572,000	7,638,000	7,500,000	7,937,000
Total Russia in Europe	625,452,000	714,068,000	880,448,000	903,937,000	738,923,000
Total Europe	1,208,883,000	1,371,129,000	1,525,211,000	1,512,626,000	1,363,233,000
Siberia	27,994,000	22,627,000	30,523,000	15,853,000	15,620,000
Central Asia	833,000	804,000	660,000	341,000	382,000
Total Russia in Asia	28,827,000	23,431,000	31,183,000	16,194,000	16,002,000
Japan	31,563,000	37,710,000	33,818,000	38,369,000	35,000,000
Grand total	1,300,645,000	1,461,171,000	1,616,997,000	1,594,019,000	1,448,072,000

Visible supply of rye in the United States first of each month for ten years.[a]

Month.	1892–1893.	1893–1894.	1894–1895.	1895–1896.	1896–1897.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	451,000	480,000	289,000	158,000	1,575,000
August	258,000	408,000	263,000	215,000	1,630,000
September	470,000	434,000	372,000	511,000	2,328,000
October	952,000	582,000	411,000	700,000	2,040,000
November	1,309,000	658,000	556,000	1,250,000	2,596,000
December	1,576,000	723,000	508,000	1,702,000	2,695,000
January	1,442,000	717,000	583,000	1,739,000	3,276,000
February	1,157,000	720,000	508,000	1,763,000	4,266,000
March	1,139,000	638,000	423,000	1,710,000	4,104,000
April	1,046,000	532,000	366,000	1,631,000	4,128,000
May	906,000	489,000	182,000	1,481,000	3,607,000
June	675,000	302,000	177,000	1,467,000	2,798,000

[a] These figures represent stocks available at 62 of the principal points of accumulation east of the Rocky Mountains, stocks in Manitoba elevators, and stocks afloat on lakes and canals.

Month.	1897–1898.	1898–1899.	1899–1900.	1900–1901.	1901–1902.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	2,464,000	988,000	904,000	806,000	747,000
August	1,946,000	365,000	638,000	725,000	753,000
September	2,499,000	721,000	647,000	1,056,000	1,864,000
October	3,064,000	894,000	962,000	1,216,000	2,440,000
November	3,832,000	1,260,000	1,906,000	1,513,000	2,863,000
December	3,932,000	1,212,000	1,892,000	1,754,000	3,463,000
January	4,436,000	1,573,000	1,806,000	1,651,000	3,257,000
February	4,291,000	1,576,000	1,734,000	1,530,000	3,270,000
March	4,099,000	1,724,000	1,951,000	1,532,000	2,972,000
April	3,682,000	1,658,000	1,566,000	1,333,000	2,639,000
May	3,039,000	1,335,000	1,441,000	1,112,000	1,910,000
June	1,526,000	975,000	1,206,000	938,000	....

Condition of the rye crop of the United States, monthly, 1885–1901.

Year.	Apr.	May.	June.	July.	Aug.	When harvested.	Year.	Apr.	May.	June.	July.	Aug.	When harvested.
1885...	87.7	86.0	83.0	87.0	94.0	....	1894..	94.4	90.7	93.2	93.9	79.8	86.9
1886...	96.6	95.7	94.4	95.6	88.6	93.4	1895..	87.0	88.7	85.7	82.2	84.0	83.7
1887...	92.0	90.8	88.9	88.0	84.6	82.2	1896..	82.9	87.7	85.2	83.8	88.0	82.0
1888...	93.5	92.9	93.9	95.1	91.4	92.8	1897..	88.9	88.0	89.9	95.0	89.8	90.1
1889...	93.9	96.5	95.2	96.7	95.4	91.6	1898..	92.1	94.5	97.1	93.8	93.7	89.4
1890...	92.8	93.5	92.3	92.0	86.8	85.4	1899..	84.9	85.2	84.5	83.3	89.0	82.0
1891...	95.4	97.2	95.4	93.9	89.6	95.1	1900..	84.8	88.5	87.6	89.6	76.0	84.2
1892...	87.0	88.9	91.0	92.9	89.8	88.5	1901..	93.1	94.6	93.9	93.5	83.6	84.0
1893...	85.7	82.7	84.6	83.8	78.5	82.0							

Acreage, production, value, prices, and exports of rye of the United States, 1866–1901.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1.	Farm value, Dec. 1.	Chicago cash price per bushel, No. 2. December. Low.	December. High.	May of following year. Low.	May of following year. High.	Domestic exports, including rye flour, fiscal years beginning July 1.
	Acres.	*Bush.*	*Bushels.*	*Cents.*	*Dollars.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Bushels.*
1866.....	1,548,033	13.5	20,864,944	82.2	17,149,716	......	......	142	150	234,971
1867.....	1,689,175	13.7	23,184,000	100.4	23,280,584	132	157	173	185	564,901
1868.....	1,651,321	13.6	22,504,800	94.9	21,349,190	106½	118	100	115½	92,869
1869.....	1,657,584	13.6	22,527,900	77.0	17,341,861	66	77½	78	83½	199,450
1870.....	1,176,137	13.2	15,473,600	73.2	11,326,967	67	74	81	91	87,174
1871.....	1,069,531	14.4	15,365,500	71.1	10,927,623	62	63¾	75	93	832,689
1872.....	1,048,654	14.2	14,888,600	67.6	10,071,061	57½	70	68½	70	611,749
1873.....	1,150,355	13.2	15,142,000	70.3	10,638,258	70	81	91	102	1,923,404
1874.....	1,116,716	13.4	14,990,900	77.4	11,610,339	93	99½	103	107½	267,058
1875.....	1,359,788	13.0	17,722,100	67.1	11,894,223	67	68¾	61½	70½	589,159
1876.....	1,468,374	13.9	20,374,800	61.4	12,504,970	65½	73	70	92½	2,234,856
1877.....	1,412,902	15.0	21,170,100	57.6	12,201,759	55½	56½	54	60	4,249,684
1878.....	1,622,700	15.9	25,842,790	52.5	13,566,002	44	44½	47	52	4,877,821
1879.....	1,625,450	14.5	23,639,460	65.6	15,507,431	73½	81	73½	85	2,943,894
1880.....	1,767,619	13.9	24,540,829	75.6	18,564,560	82	91½	115	118	1,955,155
1881.....	1,789,100	11.6	20,704,950	93.3	19,327,415	96½	98	77	83	1,003,609
1882.....	2,227,894	13.4	29,960,037	61.5	18,439,194	57	58½	62	67	2,206,212
1883.....	2,314,754	12.1	28,058,582	58.1	16,300,503	56½	60	60½	62½	6,247,590
1884.....	2,343,963	12.2	28,640,000	51.9	14,857,040	51	52	68	73	2,974,390
1885.....	2,129,301	10.2	21,756,000	57.9	12,594,820	58½	61	58	61	216,699
1886.....	2,129,918	11.5	24,489,000	53.8	13,181,330	53	54½	54½	56½	377,302
1887.....	2,053,447	10.1	20,693,000	54.5	11,283,140	55½	61½	63	68	94,827
1888.....	2,364,805	12.0	28,415,000	58.8	16,721,869	50	52	39	41½	309,266
1889.....	2,171,493	13.1	28,420,299	42.3	12,009,752	44	45½	49½	54	2,280,975
1890.....	2,141,853	12.0	25,807,472	62.9	16,229,992	64½	68½	83	92	358,263
1891.....	2,176,466	14.6	31,751,868	77.4	24,589,217	86	92	70¼	79	12,068,628
1892.....	2,163,657	12.9	27,978,824	54.2	15,160,056	46	51	50½	62	1,493,924
1893.....	2,038,485	13.0	26,555,446	51.3	13,612,222	45	47½	44½	48	249,152
1894.....	1,944,780	13.7	26,727,615	50.1	13,395,476	47½	49	62½	67	32,045
1895.....	1,890,345	14.4	27,210,070	44.0	11,964,826	32	35¾	33	36½	1,011,128
1896.....	1,831,201	13.3	24,369,047	40.9	9,960,769	37	42½	32¾	35½	8,575,667
1897.....	1,703,561	16.1	27,363,324	44.7	12,239,647	45¾	47	48	75	15,562,035
1898.....	1,643,207	15.6	25,657,522	46.3	11,875,350	52½	55½	56½	62	10,169,822
1899.....	1,659,308	14.4	23,961,741	51.0	12,214,118	49	52	53	56½	2,382,012
1900.....	1,591,362	15.1	23,995,927	51.2	12,295,417	45¾	49¾	51½	54	2,345,512
1901.....	1,987,505	15.3	30,344,830	55.7	16,909,742	59	65¾	......	......	....

Acreage, production, and value of rye in the United States in 1901, by States.

States and Territories.	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Average value per acre.	Farm value, Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*	*Dollars.*
Vermont.....................	1,963	18.3	35,923	80	14.64	28,738
Massachusetts................	4,544	15.9	72,250	79	12.56	57,078
Connecticut..................	10,895	18.0	196,110	72	12.96	141,199
New York.....................	163,183	14.9	2,431,427	62	9.24	1,507,485
New Jersey	69,308	15.0	1,039,620	59	8.85	613,376
Pennsylvania.................	383,596	15.9	6,099,176	60	9.54	3,659,506
Delaware	1,125	15.3	17,212	58	8.87	9,983

Acreage, production, and value of rye in the United States in 1901, by States—Continued.

States and Territories.	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Average value per acre.	Farm value, Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*	*Dollars.*
Maryland	21,814	14.4	314,122	56	8.06	175,908
Virginia	28,733	11.1	318,936	61	6.77	194,551
North Carolina	26,191	8.5	222,624	78	6.63	173,647
South Carolina	4,270	7.7	32,879	111	8.55	36,496
Georgia	14,497	7.6	110,177	106	8.06	116,788
Alabama	1,840	8.0	14,720	104	8.32	15,309
Texas	3,825	11.1	42,458	93	10.32	39,486
Arkansas	2,512	8.7	21,854	89	7.74	19,450
Tennessee	14,658	11.3	165,635	74	8.36	122,570
West Virginia	12,169	12.0	146,028	65	7.80	94,918
Kentucky	15,387	14.0	215,418	67	9.38	144,330
Ohio	15,744	16.9	266,074	55	9.30	146,341
Michigan	156,857	14.0	2,195,998	52	7.28	1,141,919
Indiana	41,279	14.5	598,546	53	7.68	317,229
Illinois	75,355	17.0	1,281,035	57	9.69	730,190
Wisconsin	322,110	15.9	5,121,549	52	8.27	2,663,205
Minnesota	97,983	19.3	1,891,072	49	9.46	926,625
Iowa	76,625	18.4	1,409,900	50	9.20	704,950
Missouri	20,377	14.2	289,358	67	9.51	193,867
Kansas	88,913	14.3	1,271,456	55	7.87	699,301
Nebraska	155,475	15.0	2,332,125	46	6.90	1,072,778
South Dakota	38,659	14.4	556,690	43	6.19	239,377
North Dakota	24,550	13.8	338,790	43	5.93	145,680
Montana	1,834	26.7	48,968	60	16.02	29,381
Wyoming	1,026	24.0	24,624	80	19.20	19,699
Colorado	2,659	16.1	42,810	62	9.98	26,542
Utah	3,359	14.2	47,698	65	9.23	31,004
Idaho	1,356	15.0	20,340	67	10.05	13,628
Washington	3,096	17.5	54,180	62	10.85	33,592
Oregon	10,116	15.7	158,821	66	10.36	104,822
California	66,087	12.8	845,914	57	7.30	482,171
Oklahoma	3,535	14.8	52,318	70	10.36	36,623
United States	1,987,505	15.3	30,344,830	55.7	8.51	16,909,742

Average yield per acre of rye in the United States, 1892–1901, by States.

States and Territories.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	13.5	12.0	16.5	19.2	18.0	13.5	18.0	15.0	17.2	......
New Hampshire	14.0	15.1	15.4	16.0	19.6	18.0	17.5	15.0	17.1	......
Vermont	14.3	14.0	13.1	16.0	18.6	16.0	19.1	17.0	16.6	18.3
Massachusetts	15.2	16.2	19.2	19.9	22.0	19.5	16.7	16.0	16.9	15.9
Connecticut	14.3	15.9	12.9	16.9	15.4	19.0	18.0	18.0	17.0	18.0
New York	12.7	14.9	15.4	18.1	14.3	18.5	17.5	16.0	15.1	14.9
New Jersey	13.5	13.4	14.8	13.6	13.8	17.0	15.5	15.0	15.9	15.0
Pennsylvania	12.6	14.7	13.9	15.1	16.0	19.0	16.1	15.0	15.3	15.9
Delaware	......	......	......	......	......	......	......	......	......	15.3
Maryland	11.3	13.1	13.5	12.9	9.2	17.0	14.5	14.0	16.5	14.4
Virginia	8.8	9.3	8.8	11.0	10.0	11.0	11.2	9.0	10.5	11.1
North Carolina	6.5	7.7	9.0	7.7	7.5	8.8	9.1	7.0	8.9	8.5
South Carolina	6.0	5.4	4.7	9.3	4.8	6.6	8.5	5.0	7.5	7.7
Georgia	6.0	6.4	6.5	7.2	7.1	7.4	8.0	6.0	7.0	7.6
Alabama	6.5	9.8	13.3	10.2	8.0	9.6	11.1	8.0	7.8	8.0
Texas	11.2	9.3	11.3	5.5	7.0	12.0	12.0	10.0	16.5	11.1
Arkansas	8.2	7.5	9.0	10.0	10.0	11.0	11.4	11.0	11.5	8.7
Tennessee	8.7	9.5	7.6	7.2	9.0	10.0	10.5	9.0	11.0	11.3
West Virginia	9.5	8.2	8.0	16.1	10.6	11.5	11.2	10.0	10.5	12.0
Kentucky	11.3	13.2	12.2	13.2	11.0	13.0	13.0	10.0	13.1	14.0
Ohio	12.6	15.2	18.3	14.8	9.6	18.0	17.4	16.0	16.6	16.9
Michigan	13.7	12.8	13.2	13.6	9.2	75.0	15.8	14.0	14.6	14.0
Indiana	12.5	14.4	19.3	12.2	10.6	13.0	15.5	13.0	15.1	14.5
Illinois	12.3	13.9	18.6	15.2	15.3	15.5	14.8	15.0	17.2	17.0
Wisconsin	13.7	14.5	16.0	16.1	14.5	16.0	15.3	15.0	15.8	15.9
Minnesota	17.1	15.3	17.5	21.1	15.6	17.2	20.5	18.0	19.5	19.3
Iowa	13.2	14.6	16.9	20.6	17.5	16.0	19.0	18.0	18.0	18.4
Missouri	12.5	12.8	15.4	12.2	12.2	12.0	13.1	13.0	14.0	14.2
Kansas	15.0	7.0	5.8	5.9	7.0	14.0	15.6	11.0	15.2	14.3
Nebraska	14.5	10.1	6.1	9.3	16.9	17.0	18.8	16.0	14.2	15.0
South Dakota	12.5	10.6	4.5	8.4	11.6	16.5	16.6	15.0	10.6	14.4
North Dakota	11.8	12.3	15.0	21.3	12.0	14.5	15.0	15.0	5.2	13.8
Montana	......	......	......	......	......	......	......	......	......	26.7
Wyoming	......	......	......	......	......	......	......	......	......	24.0
Colorado	14.6	21.0	15.6	14.5	23.5	15.0	18.0	14.0	16.8	16.1
Utah	13.2	11.9	19.0	19.8	20.0	12.0	19.5	17.0	17.5	14.2
Idaho	......	......	......	......	......	......	......	......	......	15.0
Washington	17.0	15.1	14.4	26.7	15.0	19.5	18.0	16.0	16.8	17.5
Oregon	12.0	10.5	14.1	11.2	12.7	15.0	14.4	11.0	16.1	15.7
California	11.5	17.5	13.2	11.6	14.3	12.2	9.0	15.0	13.0	12.8
Oklahoma	......	......	......	......	......	......	......	......	......	14.8
General average	12.70	13.03	13.74	14.40	13.31	16.06	15.61	14.44	15.1	15.3

Average yield of rye in certain countries, in bushels per acre, 1894–1900.

Year.	United States.	Russia.	Germany.	Austria.	Hungary.	France.	Ireland.
	(a)	(b)	(b)	(b)	(b)	(a)	(b)
1894	13.7	12.7	22.0	17.2	19.5	19.5	25.4
1895	14.4	11.6	20.9	14.5	16.7	18.8	26.8
1896	13.3	10.9	22.7	16.3	18.2	18.7	25.4
1897	16.1	9.3	21.8	13.9	13.5	13.4	21.6
1898	15.6	10.5	24.2	17.7	16.9	18.3	25.8
1899	14.4	12.8	23.6	18.7	17.7	18.2	25.7
1900	15.1	12.5	22.9	13.0	15.1	16.9	26.4
Average	14.7	11.5	22.6	15.9	16.8	17.7	25.3

[a] Winchester bushels. [b] Bushels of 56 pounds.

Average value per acre of rye in the United States, 1892–1901, by States.

States and Territories.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
Maine	$11.34	$12.96	$13.37	$16.32	$12.06	$11.07	$15.12	$12.60	$14.10	......
New Hampshire	11.62	11.78	11.40	12.16	14.11	15.12	13.12	12.15	14.02	......
Vermont	10.44	10.22	9.56	9.12	12.09	9.60	11.08	10.54	10.13	$14.64
Massachusetts	10.94	12.15	14.02	13.33	15.40	11.90	10.52	12.64	12.68	12.56
Connecticut	10.44	10.49	8.39	10.65	8.78	11.21	10.80	11.52	11.05	12.96
New York	8.26	9.39	8.32	8.69	6.29	8.88	8.75	8.96	8.46	9.24
New Jersey	8.37	9.38	8.14	6.94	6.49	8.50	7.75	8.25	8.74	8.85
Pennsylvania	7.81	8.38	7.78	7.55	7.52	8.17	7.57	7.65	8.11	9.54
Delaware	......	......	......	......	......	......	......	......	......	8.87
Maryland	7.01	6.68	6.35	6.32	4.42	7.82	7.83	7.98	8.58	8.06
Virginia	5.54	5.21	4.75	5.72	4.80	5.50	5.15	4.77	6.09	6.77
North Carolina	5.52	5.39	6.30	4.93	5.32	5.28	5.82	5.25	6.76	6.63
South Carolina	5.88	5.94	4.51	10.70	4.18	5.68	8.67	5.45	7.87	8.55
Georgia	6.00	6.91	6.31	6.12	7.17	6.81	7.84	6.72	7.21	8.06
Alabama	6.50	11.27	12.64	8.57	7.04	11.33	11.65	8.32	8.03	8.32
Texas	7.84	6.32	8.48	4.13	4.69	8.64	8.52	8.20	11.05	10.32
Arkansas	6.72	4.35	6.84	6.20	7.00	9.46	7.41	8.14	8.28	7.74
Tennessee	5.65	5.60	4.48	4.46	5.40	5.80	5.56	6.03	7.48	8.36
West Virginia	6.37	5.33	4.56	9.82	5.94	5.87	5.82	6.20	6.72	7.80
Kentucky	7.01	7.66	7.20	7.39	5.94	6.89	7.15	7.00	8.25	9.38
Ohio	7.06	7.14	8.23	6.66	3.74	7.92	7.83	8.80	9.13	9.30
Michigan	7.26	5.63	6.07	5.44	2.94	6.30	6.58	7.28	7.01	7.28
Indiana	6.50	6.48	8.11	5.12	3.82	5.46	6.67	6.24	7.55	7.68
Illinois	6.15	5.70	8.00	6.08	5.20	6.82	6.51	7.05	8.08	9.69
Wisconsin	6.58	6.24	6.88	5.64	4.82	6.56	6.58	7.20	7.74	8.27
Minnesota	7.52	6.27	7.53	5.91	4.68	6.36	7.79	7.56	8.19	9.46
Iowa	6.47	5.99	7.77	6.39	5.08	5.76	7.60	7.20	7.38	9.20
Missouri	6.25	5.76	7.24	4.76	5.73	5.28	6.16	6.50	7.14	9.51
Kansas	6.00	2.66	2.67	2.24	2.45	5.60	5.77	4.62	6.54	7.87
Nebraska	5.65	3.54	2.93	2.79	3.72	5.44	6.39	6.08	5.68	6.90
South Dakota	4.62	3.92	2.07	2.10	3.13	5.78	5.64	5.55	4.13	6.19
North Dakota	5.19	3.94	5.55	5.75	2.64	5.22	5.40	5.55	2.13	5.93
Montana	......	......	......	......	......	......	......	......	......	16.02
Wyoming	......	......	......	......	......	......	......	......	......	19.20
Colorado	7.59	10.50	10.30	6.96	14.57	7.80	9.00	6.72	9.07	9.98
Utah	7.26	5.59	10.83	6.93	8.00	7.20	8.97	8.16	9.10	9.23
Idaho	......	......	......	......	......	......	......	......	......	10.05
Washington	9.35	10.42	8.06	20.03	7.50	12.09	10.44	9.60	9.45	10.85
Oregon	7.20	7.66	8.04	6.05	7.62	8.85	10.37	7.70	9.82	10.36
California	7.70	10.50	7.92	6.73	8.70	7.93	6.30	11.70	7.54	7.30
Oklahoma	......	......	......	......	......	......	......	......	......	10.36
General average	6.98	6.68	6.89	6.33	5.44	7.18	7.23	7.36	7.73	8.51

Average farm price of rye per bushel in the United States December 1, 1892–1901, by States.

States and Territories.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	84	108	81	85	67	82	84	84	82	......
New Hampshire	83	78	74	76	72	84	75	81	82	......
Vermont	73	73	73	57	65	60	58	62	61	80
Massachusetts	72	75	73	67	70	61	63	79	75	79
Connecticut	73	66	65	63	57	59	60	64	65	72
New York	65	63	54	48	44	48	50	56	56	62
New Jersey	62	70	55	51	47	50	50	55	55	59
Pennsylvania	62	57	56	50	47	43	47	51	53	60
Delaware	......	......	......	......	......	......	......	......	......	58
Maryland	62	51	47	49	48	46	54	57	52	56
Virginia	63	56	54	52	48	50	46	53	58	61
North Carolina	85	70	70	64	71	60	64	75	76	78
South Carolina	98	110	96	115	87	86	102	109	105	111
Georgia	100	108	97	85	101	92	98	112	103	106
Alabama	100	115	95	84	88	118	105	104	103	104
Texas	70	68	75	75	67	72	71	82	67	93

Average farm price of rye per bushel in the United States December 1, 1892–1901, by States—Continued.

States and Territories.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Arkansas	82	58	76	72	70	86	65	74	72	89
Tennessee	65	59	59	62	60	58	53	67	68	74
West Virginia	67	65	57	61	56	51	52	62	64	65
Kentucky	62	58	59	56	54	53	55	70	63	67
Ohio	56	47	45	45	39	44	45	55	55	55
Michigan	53	44	46	40	32	42	43	52	48	52
Indiana	52	45	42	42	36	42	43	48	50	53
Illinois	50	41	43	40	34	44	44	47	47	57
Wisconsin	48	43	43	35	33	41	43	48	49	52
Minnesota	44	41	43	28	30	37	38	42	42	49
Iowa	49	41	46	31	29	36	40	40	41	50
Missouri	50	45	47	39	47	44	47	50	51	67
Kansas	40	38	46	38	35	40	37	42	43	55
Nebraska	39	35	48	30	22	32	34	38	40	46
South Dakota	37	37	46	25	27	35	34	37	39	43
North Dakota	44	32	37	27	22	36	36	37	41	43
Montana	......	......	......	......	......	......	......	......	......	60
Wyoming	......	......	......	......	......	......	......	......	......	80
Colorado	52	50	66	48	62	52	50	48	54	62
Utah	55	47	57	35	40	60	46	48	52	65
Idaho	......	......	......	......	......	......	......	......	......	67
Washington	55	69	56	75	50	62	58	60	58	62
Oregon	60	73	57	54	60	59	72	70	61	66
California	67	60	60	58	60	65	70	78	58	57
Oklahoma	......	......	......	......	......	......	......	......	......	70
General average	54.18	51.26	50.12	43.97	40.87	44.73	46.28	50.97	51.2	55.7

Transportation rates, average for rye in sacks, in cents per 100 pounds, St. Louis to New Orleans by river.

1881	20.00	1888	15.00	1895	12.50
1882	20.00	1889	17.93	1896	14.55
1883	17.75	1890	15.66	1897	15.00
1884	14.00	1891	16.28	1898	10.00
1885	15.00	1892	16.87	1899	10.00
1886	16.00	1893	17.54	1900	10.00
1887	18.25	1894	17.14	1901	10.00

Wholesale prices of rye per bushel in leading cities of the United States, 1897–1901.

Date.	New York.		Cincinnati.		Chicago.		Duluth.	
	Prime State.		No. 2.		No. 2.			
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
1897.								
January	40	46	36	44	35¼	38¼	34	39
February	39	45	36	42	32⅛	36	33	35¼
March	40	44	36	41⅛	32	34½	32⅛	35
April	37	45	36	39	31⅜	36¼	30	37⅛
May	38	43	35	42⅛	32¾	35⅛	33	35⅛
June	38	42	33	39	32⅛	35	33⅛	35
July	38	46	33	36	33⅛	42	34	41⅛
August	42	55	35	52	41	56	42	53
September	47	58	46	50	46	53	45	52⅛
October	52	54⅛	45	47	44	48	44	48
November	53	54⅛	46	47	45	48	45	47⅛
December	53	55	46	48	45¾	47	45⅛	46¾
1898.								
January	54¼	57⅛	45⅛	53	44¼	48	45	47⅛
February	55⅛	59⅛	48	53	46¾	50⅛	46¼	50
March	58	60	52	54⅛	48¾	50⅛	48	49⅛
April	57⅛	69	52	66	50	62	49	62¼
May	60	74¾	52	80	48	75	48	72
June	49	58	40	51	41	49	41	51
July	50	55⅛	40	45	42¾	48⅛	41⅛	48⅛
August	49⅛	52⅛	45	50	41	46⅛	40⅛	45⅛
September	50	54⅛	45	48⅛	42⅛	49	42¾	47
October	53	60	48	57	44⅛	51⅛	44	50
November	58	60	56	59	49⅛	52¾	50	51
December	59¼	64	56	58⅛	52⅛	55⅛	50	54
1899.								
January	63¾	67⅛	57	65	53⅛	58¾	58	58
February	64⅛	68	60	65	54	56¼	54⅛	56
March	63	67⅛	59	65	49¼	56⅛	48⅛	55¾
April	63	68⅛	60	65	52	59	50⅛	58

Wholesale prices of rye per bushel in leading cities of the United States, 1897–1901—C't'd.

Date.	New York. Prime State. Low.	New York. Prime State. High.	Cincinnati. No. 2. Low.	Cincinnati. No. 2. High.	Chicago. No. 2. Low.	Chicago. No. 2. High.	Duluth. Low.	Duluth. High.
1899.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
May	65	67	62	68	56½	62	56	58⅛
June	64	66½	64	68	56	62	56	59⅛
July	60	65½	57	67	51	60	50	58
August	59	61¾	56	60	51½	56½	50½	53⅛
September	61½	66	58	65	54	58	52¾	57⅛
October	61	63	61½	65½	54¼	58	53	57¼
November	56	62	59	64	49	53	48	52
December	58½	61½	60	65½	49	52	47	49⅛
1900.								
January	60	61¼	59	64	50	52	48½	50
February	60½	64½	61	65	51	55½	50	53
March	60½	63½	60	64	52½	55	51	53⅛
April	60½	63½	60	63½	53	55½	51⅛	52⅛
May	60¼	62½	61	63½	53	56¼	51¾	53¾
June	61½	68	61	67	52¾	60½	52½	60⅛
July	57	65	59	66	50	58	49	57⅛
August	54½	58	51½	60	48	51½	48	50½
September	56¾	60½	53	57	50¼	53½	50	53⅛
October	56	61	55	59	47¼	52¼	48	53
November	54	56	52	56	44⅛	48	46	48¾
December	54	56	52	55½	45¾	49¾	46¼	48⅛
1901.								
January	57	59	53	58½	47½	49¾	48	50
February	59½	61	56	59	48½	50¼	49¼	50⅛
March	60¼	61	55	59	49½	51½	50¼	51¼
April	58½	60½	54	58½	48¾	53	49¾	53
May	59	61¾	57	62	51⅛	54	51	53
June	55	59½	55	61	46¾	53	46½	51⅛
July	51½	61	45	55½	47	57	46½	53⅛
August	59	61	52½	64	52	60	50	57¼
September	59	62	56½	60	52⅛	56	50	57½
October	58	62½	56½	59½	53¼	56	50⅛	52⅛
November	63	68	57	65½	54½	61	52⅛	57½
December	68½	72½	64½	73	59	65¾	57½	62⅛

Monthly average prices of rye in Chicago.[a]

[Cents per bushel.]

	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
January	44	68⅝	82⅛	54	44¾	49¼	36⅞	36	46⅛	56⅛	51	48⅝
February	42¾	79	83	52	45	51⅛	39⅛	34	48⅝	55⅛	53¼	49⅞
March	42⅝	89⅞	80⅛	49½	47¼	52⅛	37⅝	33¼	49⅜	52[illegible]	53¾	50⅛
April	46¾	88½	73¼	49⅛	48	60	36¼	33¾	56	55⅛	54¼	50⅞
May	51⅝	87⅛	74⅛	57	46½	64¾	34¾	34⅛	61⅛	59¼	54⅝	52⅜
June	49¼	79½	77	50¼	47½	63¾	31¼	33¾	45	59	57⅝	49⅞
July	50⅝	71¼	70	47	44	51	30⅛	37¾	45⅝	55⅛	54	52
August	64¾	91¾	62	45	45¾	42	30	48⅛	43¾	54	49¾	56
September	60¾	86½	56¾	43½	47¼	39	33⅛	49⅛	45¾	56	51⅞	54¼
October	63¼	87⅜	52	45	47	39	37⅛	46	48	56⅛	49¾	54⅝
November	68½	91¾	50	45⅛	47¼	36⅛	39½	46½	51⅛	51	46¼	57⅞
December	66½	89	49¼	46⅛	48⅞	34	39¾	46⅝	54	50⅛	47⅝	62⅜
Yearly average	54¼	84¼	67 9/16	48¾	46½	48½	35⅛	40	49½	55 1/16	52	53⅛

[a] This table exhibits average cash prices for the past twelve years. The monthly prices are the means between the lowest and highest prices for each month, and the yearly prices are the averages of the monthly averages.

BUCKWHEAT.

Condition of buckwheat crop of United States, monthly, 1886–1901.

Year.	Aug.	Sept.	Oct.	Year.	Aug.	Sept.	Oct.	Year.	Aug.	Sept.	Oct.	Year.	Aug.	Sept.	Oct.
1886	94.1	89.8	86.5	1890.	90.1	90.5	90.7	1894.	82.3	69.2	72.0	1898.	87.2	88.8	76.2
1887	93.3	89.1	76.6	1891.	97.3	96.6	92.7	1895.	85.2	87.5	84.8	1899.	93.2	75.2	70.2
1888	92.5	93.7	79.1	1892.	92.9	89.0	85.6	1896.	96.0	93.2	86.0	1900.	87.9	80.5	72.8
1889	95.2	92.1	90.0	1893.	88.8	77.5	73.5	1897.	94.9	95.1	90.8	1901.	91.1	90.9	90.5

Acreage, production, value, and price of buckwheat in the United States, 1866–1901.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1.	Farm value, Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*
1866	1,045,624	21.8	22,791,839	67.6	15,413,160
1867	1,227,826	17.4	21,359,000	78.7	16,812,070
1868	1,113,993	17.8	19,863,700	78.0	15,490,426
1869	1,028,693	16.9	17,431,100	71.9	12,534,851
1870	536,992	18.3	9,841,500	70.5	6,937,471
1871	413,915	20.1	8,328,700	74.5	6,208,165
1872	448,497	18.1	8,133,500	73.5	5,979,222
1873	454,152	17.3	7,837,700	75.0	5,878,629
1874	452,590	17.7	8,016,600	72.9	5,843,645
1875	575,530	17.5	10,082,100	62.0	6,254,564
1876	666,441	14.5	9,668,800	66.6	6,435,836
1877	649,923	15.7	10,177,000	66.9	6,808,180
1878	673,100	18.2	12,246,820	52.6	6,441,240
1879	639,900	20.5	13,140,000	59.8	7,856,191
1880	822,802	17.8	14,617,535	59.4	8,682,488
1881	828,815	11.4	9,486,200	86.5	8,205,705
1882	847,112	13.0	11,019,353	73.0	8,038,862
1883	857,349	8.9	7,668,954	82.2	6,303,980
1884	879,403	12.6	11,116,000	58.9	6,549,020
1885	914,394	13.8	12,626,000	55.9	7,057,363
1886	917,915	12.9	11,869,000	54.5	6,465,120
1887	910,506	11.9	10,844,000	56.5	6,122,320
1888	912,630	13.2	12,050,000	63.3	7,627,647
1889	837,162	14.5	12,110,329	50.5	6,113,119
1890	844,579	14.7	12,432,831	57.4	7,132,872
1891	849,364	15.0	12,760,932	57.0	7,271,506
1892	861,451	14.1	12,143,185	51.8	6,295,643
1893	815,614	14.9	12,132,311	58.4	7,074,450
1894	789,232	16.1	12,668,200	55.6	7,040,238
1895	763,277	20.1	15,341,399	45.2	6,936,325
1896	754,898	18.7	14,089,783	39.2	5,522,339
1897	717,836	20.9	14,997,451	42.1	6,319,188
1898	678,332	17.3	11,721,927	45.0	5,271,462
1899	670,148	16.6	11,094,473	55.7	6,183,675
1900	637,930	15.0	9,566,966	55.8	5,341,413
1901	811,164	18.6	15,125,939	56.3	8,523,317

Acreage, production, and value of buckwheat in the United States, in 1901, by States.

States.	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Average value per acre.	Farm value, Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*	*Dollars.*
Maine	25,470	31.7	807,399	48	15.22	387,552
New Hampshire	1,915	21.0	40,215	55	11.55	22,118
Vermont	10,153	25.1	254,840	59	14.81	150,356
Massachusetts	2,523	18.9	47,685	61	11.53	29,088
Connecticut	3,644	18.0	65,592	65	11.70	42,635
New York	338,399	18.8	6,361,901	57	10.72	3,626,284
New Jersey	13,963	19.0	265,297	52	9.88	137,954
Pennsylvania	242,402	19.5	4,726,839	56	10.92	2,647,030
Delaware	1,505	17.8	26,789	55	9.79	14,734
Maryland	8,375	17.5	146,562	60	10.50	87,937
Virginia	18,462	15.9	293,546	56	8.90	164,386
North Carolina	5,343	15.6	83,351	62	9.67	51,678
Tennessee	900	14.2	12,780	59	8.38	7,540
West Virginia	21,024	20.6	433,094	59	12.15	255,525
Ohio	10,286	16.1	165,605	60	9.66	99,363
Michigan	44,789	14.1	631,525	51	7.19	322,078
Indiana	6,316	13.1	82,740	61	7.99	50,471
Illinois	5,319	11.0	58,509	70	7.70	40,956
Wisconsin	30,670	12.4	380,308	59	7.32	224,382
Minnesota	5,502	14.5	79,779	62	8.99	49,463
Iowa	8,042	13.5	108,567	70	9.45	75,997
Missouri	1,962	6.0	11,772	76	4.56	8,947
Kansas	1,960	7.9	15,484	75	5.92	11,613
Nebraska	983	11.5	11,304	58	6.67	6,556
North Dakota	1,257	11.5	14,456	60	6.90	8,674
United States	811,164	18.6	15,125,939	56.3	10.51	8,523,317

Average yield per acre of buckwheat in the United States, 1892–1901, by States.

States.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	19.0	29.0	37.8	38.6	42.3	35.0	26.5	22.0	30.0	31.7
New Hampshire	17.5	23.2	20.0	29.9	27.2	27.0	20.0	20.0	22.0	21.0
Vermont	20.0	29.2	22.4	34.5	31.4	24.0	21.4	23.0	25.0	25.1
Massachusetts	11.5	27.5	18.9	15.0	18.3	19.0	20.0	20.0	17.0	18.9
Connecticut	20.0	15.8	16.4	15.4	14.2	17.0	19.0	19.0	16.0	18.0
New York	14.7	14.4	15.5	21.4	18.8	22.0	16.8	13.0	14.0	18.8
New Jersey	12.5	14.4	14.4	18.7	20.7	16.0	21.0	21.0	16.0	19.0
Pennsylvania	14.5	14.1	18.0	19.9	17.3	21.0	17.2	20.0	14.0	19.5
Delaware	......	20.0	20.0	10.0	20.0	19.0	16.5	18.0	13.0	17.8
Maryland	12.5	11.8	20.0	10.9	22.7	19.0	12.2	13.0	15.0	17.5
Virginia	8.3	13.3	14.7	10.1	18.0	14.0	17.3	14.0	13.0	15.9
North Carolina	7.2	11.5	18.7	12.0	20.0	11.0	19.5	17.0	13.0	15.6
Tennessee	7.5	12.6	12.8	10.0	24.0	18.0	18.0	12.0	14.0	14.2
West Virginia	16.3	11.5	22.6	18.8	19.5	19.0	20.5	17.0	17.0	20.6
Ohio	12.6	12.0	14.9	14.6	18.8	18.0	20.0	16.0	16.0	16.1
Michigan	13.0	13.9	12.0	17.2	15.3	17.0	14.2	11.0	14.0	14.1
Indiana	11.5	6.9	14.8	14.3	24.0	14.0	18.4	16.0	14.0	13.1
Illinois	11.3	11.6	11.7	13.3	13.8	13.0	14.0	15.0	15.0	11.0
Wisconsin	13.5	15.8	8.5	17.9	13.5	18.0	15.5	15.0	14.0	12.4
Minnesota	13.8	15.2	9.2	15.3	10.6	17.0	15.0	17.0	15.0	14.5
Iowa	10.7	13.2	13.6	13.5	16.2	17.0	16.0	16.0	15.0	13.5
Missouri	11.3	12.7	9.2	10.2	21.8	15.0	15.8	14.0	13.0	6.0
Kansas	......	......	......	......	......	......	......	......	......	7.9
Nebraska	8.2	14.7	3.7	6.7	21.3	14.0	12.8	16.0	16.0	11.5
North Dakota	......	......	......	......	......	......	......	......	......	11.5
Oregon	11.2	20.0	38.0	15.5	21.0	18.0	14.0	17.0	13.0	......
General average	14.10	14.86	16.05	20.10	18.66	20.89	17.28	16.56	15.0	18.6

Average value per acre of buckwheat in the United States, 1892–1901, by States.

States.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
Maine	$10.83	$15.66	$21.92	$17.76	$16.07	$15.40	$10.84	$9.68	$14.70	$15.22
New Hampshire	12.25	8.58	12.20	14.05	17.20	14.85	9.40	10.00	11.44	11.55
Vermont	9.60	15.48	12.77	12.77	12.56	11.04	9.84	11.96	12.50	14.81
Massachusetts	8.97	20.63	12.85	8.85	9.70	12.54	12.20	14.00	12.24	11.53
Connecticut	9.00	11.38	10.99	8.62	7.24	9.69	10.64	11.97	10.40	11.70
New York	7.35	8.64	8.37	9.42	6.96	8.80	7.56	7.67	7.98	10.72
New Jersey	7.12	9.50	9.36	9.35	8.07	7.84	11.34	11.76	9.44	9.88
Pennsylvania	7.69	8.32	9.54	8.76	6.57	8.82	7.57	10.80	7.70	10.92
Delaware	8.46	11.00	10.00	5.00	6.00	6.84	6.60	8.82	6.76	9.79
Maryland	8.12	6.84	11.20	6.10	11.12	9.69	6.47	7.28	8.55	10.50
Virginia	5.06	7.31	7.94	5.45	8.46	7.00	7.79	7.56	7.15	8.90
North Carolina	3.96	5.63	8.79	5.28	12.00	5.39	9.36	8.33	7.28	9.67
Tennessee	4.65	6.80	7.30	5.40	14.88	10.26	9.36	6.84	8.26	8.38
West Virginia	10.60	7.82	14.01	10.72	9.75	9.31	10.05	9.52	9.52	12.15
Ohio	7.43	7.20	9.83	8.03	8.08	9.00	10.20	9.28	9.28	9.66
Michigan	6.37	7.37	6.60	7.40	5.81	6.46	5.96	6.05	7.14	7.19
Indiana	6.67	3.86	8.29	8.29	12.24	6.86	9.38	9.44	8.54	7.99
Illinois	6.78	6.61	9.01	5.85	6.21	7.41	7.28	8.70	9.75	7.70
Wisconsin	6.08	9.01	4.76	8.23	5.13	6.84	6.20	9.45	8.26	7.32
Minnesota	6.21	8.06	5.43	7.80	4.35	7.65	7.35	8.84	8.55	8.99
Iowa	6.42	8.05	10.20	6.75	7.45	8.33	7.69	9.28	9.60	9.45
Missouri	7.35	7.37	5.52	5.92	15.26	9.00	9.48	8.54	8.97	4.56
Kansas	......	......	......	......	......	......	......	......	......	5.92
Nebraska	4.10	7.64	2.52	4.36	10.65	7.14	7.81	9.92	10.24	6.67
North Dakota	......	......	......	......	......	......	......	......	......	6.90
Oregon	8.40	10.00	20.90	7.75	14.28	9.90	8.12	12.58	10.01	......
General average	7.31	8.67	8.92	9.09	7.32	8.80	7.77	9.23	8.37	10.51

Average farm price of buckwheat per bushel in the United States December 1, 1892–1901, by States.

States.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	57	54	58	46	38	44	39	44	49	48
New Hampshire	70	37	61	47	63	55	47	50	52	55
Vermont	48	53	57	37	40	46	46	52	50	59
Massachusetts	78	75	68	59	53	66	61	70	72	61
Connecticut	75	72	67	56	51	57	56	63	65	65
New York	50	60	54	44	37	40	45	59	57	57
New Jersey	57	66	65	50	39	49	54	56	59	52
Pennsylvania	53	59	53	44	38	42	44	54	55	56
Delaware	60	55	50	50	30	36	40	49	52	55

Average farm price of buckwheat per bushel in the United States December 1, 1892–1901, by States—Continued.

States.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maryland	65	58	56	56	49	51	53	56	57	60
Virginia	61	55	54	54	47	50	45	54	55	56
North Carolina	55	49	47	44	60	49	48	49	56	62
Tennessee	62	54	57	54	62	57	52	57	59	59
West Virginia	65	68	62	57	50	49	49	56	56	59
Ohio	59	60	66	55	43	50	51	58	58	60
Michigan	49	53	55	43	38	38	42	55	51	51
Indiana	58	56	56	58	51	49	51	59	61	61
Illinois	60	57	77	44	45	57	52	58	65	70
Wisconsin	45	57	56	46	38	38	40	63	59	59
Minnesota	45	53	59	51	41	45	49	52	57	62
Iowa	60	61	75	50	46	49	48	58	64	70
Missouri	65	58	60	58	70	60	60	61	69	76
Kansas	......	......	......	......	......	......	......	......	......	75
Nebraska	50	52	68	65	50	51	61	62	64	58
North Dakota	......	......	......	......	......	......	......	......	......	60
Oregon	75	50	55	50	68	55	58	74	77	......
General average	51.85	58.36	55.57	45.21	39.19	42.14	44.97	55.74	55.8	56.3

POTATOES.

Prices in 1901 show a marked advance in all markets. The wholesale price in St. Louis ranged from 18 cents to $1.40, as compared with 27 to 54 cents in 1900.

NOTE.—Tables showing the acreage and production of potatoes, hay, and cotton in 1901, left blank in this book, and the number and value of farm animals on January 1, 1901 and 1902, not given now, will shortly be published in circular form. Their nonappearance in the present Yearbook is due to the fact that that revision of the Department's estimates which usually follows upon the publication of the reports of the decennial census, and which has been made in the case of the cereals, could not be completed in time for the Yearbook without unduly delaying its publication.

Condition of the potato crop of the United States, monthly, 1886–1901.

Year.	July.	Aug.	Sept.	Oct.	Year.	July.	Aug.	Sep	Oct.
1886	96.6	88.8	81.4	81.0	1894	92.8	74.0	62	64.8
1887	93.2	80.8	67.3	61.5	1895	91.5	89.7	90	87.4
1888	95.7	93.2	91.6	86.8	1896	99.0	94.8	83	81.7
1889	95.1	94.3	81.7	77.9	1897	87.8	77.9	66	61.6
1890	91.7	77.4	65.7	61.7	1898	95.5	83.9	77	72.5
1891	95.3	96.5	94.8	91.8	1899	93.8	93.0	86	81.7
1892	90.0	86.8	74.8	67.7	1900	91.8	88.2	80	74.4
1893	94.8	86.0	71.8	71.2	1901	87.4	62.8	52	54.0

Acreage, production, value, prices, exports, and imports of potatoes of the United States, 1866–1900.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1	Farm value, Dec. 1.	Chicago price per bushel, Burbank.				Domestic exports, fiscal years beginning July 1.	Imports during fiscal years beginning July 1.
						December.		May of following year.			
						Low.	High.	Low.	High.		
	Acres.	*Bush.*	*Bushels.*	*Cts.*	*Dollars.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Bushels.*	*Bushels.*
1866	1,069,381	100.2	107,200,976	47.8	50,722,553	......	......	......	......	512,380	198,265
1867	1,192,195	82.0	97,783,000	65.9	64,462,486	......	......	......	......	378,605	209,555
1868	1,131,552	93.8	106,090,000	59.3	62,918,660	......	......	......	......	508,249	188,470
1869	1,222,250	109.5	133,886,000	42.9	57,481,362	......	......	......	......	596,968	75,336
1870	1,325,119	86.6	114,775,000	65.0	74,621,019	......	......	......	......	553,070	458,758
1871	1,220,912	98.7	120,461,700	53.9	64,905,189	......	......	......	......	621,587	96,259
1872	1,331,331	85.3	113,516,000	53.5	60,692,129	......	......	......	......	515,306	346,840
1873	1,295,139	81.9	106,089,000	65.2	69,153,709	......	......	......	......	497,413	549,073

Acreage, production, value, prices, exports, and imports of potatoes of the United States, 1866–1900—Continued.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1	Farm value, Dec. 1.	Chicago price per bushel, Burbank. December. Low.	December. High.	May of following year. Low.	May of following year. High.	Domestic exports, fiscal years beginning July 1.	Imports during fiscal years beginning July 1.
	Acres.	*Bush.*	*Bushels.*	*Cts.*	*Dollars.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Bushels.*	*Bushels.*
1874	1,310,041	80.9	105,981,000	61.5	65,223,314					609,642	188,757
1875	1,510,041	110.5	166,877,000	34.4	57,357,515					704,379	92,148
1876	1,741,983	71.7	124,827,000	61.9	77,319,541					529,650	3,205,555
1877	1,792,287	94.9	170,092,000	43.7	74,272,500					744,409	528,584
1878	1,776,800	69.9	124,126,650	58.7	72,923,575					625,342	2,624,149
1879	1,836,800	98.9	181,626,400	43.6	79,153,673					696,080	721,868
1880	1,842,510	91.0	167,659,570	48.3	81,062,214					638,840	2,170,372
1881	2,041,670	53.5	109,145,494	91.0	99,291,341					408,286	8,789,860
1882	2,171,635	78.7	170,972,508	55.7	95,304,844					439,443	2,362,362
1883	2,289,275	90.9	208,164,425	42.2	87,848,991					554,613	425,408
1884	2,220,980	85.8	190,642,000	39.6	75,524,290					380,868	658,633
1885	2,265,823	77.2	175,029,000	44.7	78,153,403			33	50	494,948	1,937,416
1886	2,287,136	73.5	168,051,000	46.7	78,441,940	44	47	65	90	434,864	1,432,490
1887	2,357,322	56.9	134,103,000	68.2	91,506,740	70	83	65	85	403,880	8,259,538
1888	2,533,280	79.9	202,365,000	40.2	81,413,589	30	37	24	45	471,955	883,380
1889	2,647,989	77.4	204,990,345	35.5	72,704,413	33	45	30	60	406,618	3,415,578
1890	2,651,579	55.8	148,078,915	75.8	112,205,235	82	93	95	110	341,189	5,401,912
1891	2,714,770	93.7	254,426,971	35.8	91,024,521	30	40	30	50	557,022	186,871
1892	2,547,962	61.5	156,654,819	66.1	103,567,520	60	72	70	98	845,720	4,317,021
1893	2,605,186	70.3	183,034,203	59.4	108,661,801	51	60	64	88	803,111	3,002,578
1894	2,737,973	62.4	170,787,338	53.6	91,526,787	43	58	40	70	572,957	1,341,533
1895	2,954,952	100.6	297,237,370	26.6	78,984,901	18	24	10	23	680,049	175,240
1896	2,767,465	91.1	252,234,540	28.6	72,182,350	18	26	19	26	926,646	246,178
1897	2,531,577	64.7	164,015,964	54.7	89,643,059	50	62	60	87	605,187	1,171,378
1898	2,557,729	75.2	192,306,338	41.4	79,574,772	30	36			579,833	530,420
1899	2,581,353	88.6	228,783,232	39.0	89,328,832					809,472	155,861
1900	2,611,054	80.8	210,926,897	43.1	90,811,167					741,483	371,909
1901	[See note, page 740.]										

Average yield per acre of potatoes in the United States, 1892–1900, by States.

States and Territories.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	82	120	147	163	165	59	130	139	126	[See note, page 740.]
New Hampshire	80	119	120	134	108	51	90	127	101	
Vermont	54	111	124	154	128	70	105	132	134	
Massachusetts	83	119	105	133	108	62	97	134	79	
Rhode Island	95	108	133	138	105	110	123	142	94	
Connecticut	82	87	79	128	106	54	100	130	96	
New York	68	70	77	122	89	62	73	88	81	
New Jersey	71	73	60	94	94	68	75	83	69	
Pennsylvania	60	76	64	111	109	63	54	85	58	
Delaware	42	50	50	58	78	60	49	52	48	
Maryland	60	49	52	87	90	74	58	64	55	
Virginia	58	74	59	73	93	61	68	66	58	
North Carolina	55	97	62	79	79	66	67	57	61	
South Carolina	70	83	59	90	52	65	65	56	78	
Georgia	70	74	52	58	55	52	54	46	68	
Florida	65	87	90	55	75	75	64	69	60	
Alabama	65	83	43	70	64	55	74	56	69	
Mississippi	67	81	72	58	70	59	74	61	66	
Louisiana	65	67	45	89	55	64	78	60	70	
Texas	61	53	80	89	52	60	78	64	62	
Arkansas	68	88	82	70	59	55	74	63	72	
Tennessee	67	68	55	64	62	40	52	44	54	
West Virginia	60	80	52	69	93	56	62	72	80	
Kentucky	58	68	54	86	85	47	64	51	70	
Ohio	60	58	63	63	89	42	61	71	76	
Michigan	62	75	62	101	88	72	79	66	97	
Indiana	56	51	59	66	85	31	71	76	83	
Illinois	52	53	50	77	97	38	70	96	92	
Wisconsin	65	77	45	107	78	99	98	103	103	
Minnesota	70	66	39	158	84	106	85	96	81	
Iowa	51	58	43	106	94	60	80	100	72	
Missouri	51	78	69	109	78	42	66	82	93	
Kansas	47	44	41	72	69	48	70	95	72	
Nebraska	48	44	22	67	90	69	65	94	66	
South Dakota	64	54	23	66	96	94	72	78	73	

Average yield per acre of potatoes in the United States, 1892–1900, by States—Continued.

States and Territories.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
North Dakota	75	69	84	128	102	99	87	103	52	[See note, page 740.]
Montana	100	138	111	53	170	156	104	141	134	
Wyoming	100	134	150	100	167	150	120	125	99	
Colorado	99	94	85	95	88	97	77	84	56	
New Mexico	35	70	75	80	72	90	58	49	19	
Utah	59	88	135	172	155	148	135	120	118	
Nevada	100	132	161	150	190	135	155	102	156	
Idaho	98	153	178	105	162	140	120	124	136	
Washington	100	120	125	149	125	162	108	144	116	
Oregon	70	127	112	64	87	160	86	115	110	
California	75	96	52	75	80	105	95	119	104	
General average	62.00	70.26	62.38	100.59	91.14	64.71	75.19	88.63	80.8	

Average value per acre of potatoes in the United States, 1892–1900, by States.

States and Territories.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
Maine	$63.14	$64.80	$64.68	$55.42	$62.70	$52.51	$59.80	$58.38	$61.74	[See note, page 740.]
New Hampshire	68.00	74 97	56.40	42.88	50.76	45.90	44.10	58.42	53.53	
Vermont	36.72	53.28	54.56	40.04	37.12	49.00	44.10	47.52	53.60	
Massachusetts	68.89	90.41	68.25	63.84	61.56	55.80	61.11	76.38	52.14	
Rhode Island	80.75	85.32	95.76	62.10	56.70	106.70	78.72	71.00	65.80	
Connecticut	62.32	65.25	53.72	52.48	48.76	48.60	55.00	59.80	67.20	
New York	40.95	38.50	36.96	28.06	27.59	41.54	30.66	35.20	36.45	
New Jersey	53.25	54.75	37.20	31.96	33.84	53.04	45.75	42.33	41.40	
Pennsylvania	43.20	45.60	36.48	31.08	29.43	41.58	31.32	36.55	30.74	
Delaware	26.46	32.50	25.00	22.04	27.30	39.00	33.81	26.52	28.80	
Maryland	40.80	33.32	27.56	26.10	27.00	50.32	30.74	32.64	29.70	
Virginia	34.80	47.88	33.04	27.74	31.62	42.70	37.40	36.96	34.22	
North Carolina	33.55	58.20	37.20	43.45	33.97	42.24	41.54	37.62	39.65	
South Carolina	59.50	63.91	45.43	65.70	34.32	68.25	65.00	58.24	78.00	
Georgia	56.00	68.08	42.12	41.18	41.25	52.00	40.50	38.18	52.36	
Florida	48.75	101.79	67.50	55.00	63.00	90.00	76.80	85.56	63.60	
Alabama	49.40	73.04	37.84	56.70	48.00	51.70	61.42	48.72	56.58	
Mississippi	50.92	63.04	59.04	37.12	43.40	48.38	53.28	62.22	54.78	
Louisiana	50.05	55.61	37.35	64.08	41.80	54.40	58.50	48.60	55.30	
Texas	51.85	54.59	79.20	69.42	40.56	57.00	67.08	58.24	54.56	
Arkansas	47.60	56.32	43.46	35.70	31.27	46.20	40.70	44.73	41.04	
Tennessee	32.16	33.32	26.95	25.60	24.80	29.20	29.64	28.60	31.32	
West Virginia	34.80	47.20	29.64	28.98	28.83	36.40	33.48	37.44	40.80	
Kentucky	30.16	38.08	30.24	33.54	28.05	31.49	29.44	31.11	35.00	
Ohio	38.40	38.86	32.76	20.16	23.14	26.04	25.01	30.53	30.40	
Michigan	32.86	33.75	26.66	16.16	16.72	30.96	21.33	21.12	25.22	
Indiana	40.32	37.23	31.86	20.46	21.25	19.22	29.11	32.68	31.54	
Illinois	41.60	39.22	32.00	23.10	25.22	23.56	32.20	39.36	37.72	
Wisconsin	35.10	37.73	23.85	18.19	14.82	37.62	23.52	26.78	28.84	
Minnesota	33.60	30.36	19.89	22.12	17.64	32.86	21.25	24.00	21.30	
Iowa	38.25	37.70	29.67	20.14	20.08	28.20	24.00	23.00	26.64	
Missouri	39.27	44.46	35.88	27.25	24.18	26.46	29.04	33.20	32.55	
Kansas	41.36	34.76	27.88	30.24	18.63	26.40	35.70	42.75	34.56	
Nebraska	36.00	34.76	16.94	20.10	22.50	31.74	24.05	23.50	32.34	
South Dakota	35.20	31.86	17.02	17.16	19.20	30.08	20.16	21.06	26.28	
North Dakota	30.00	33.81	38.64	21.76	21.42	32.67	29.58	27.81	25.48	
Montana	60.00	95.22	53.28	25.44	54.40	62.40	57.20	74.73	71.02	
Wyoming	70.00	87.10	90.00	56.00	71.81	82.50	78.00	76.25	67.32	
Colorado	60.39	50.76	46.75	31.85	41.36	54.32	41.58	46.20	45.92	
New Mexico	28.00	46.90	60.00	50.40	48.96	70.20	45.24	33.32	21.66	
Utah	42.48	29.04	40.50	58.48	49.60	44.40	41.85	66.00	56.64	
Nevada	58.00	52.80	56.35	57.00	72.20	98.55	139.50	91.80	87.36	
Idaho	52.92	85.68	94.34	42.00	48.60	44.80	64.80	75.64	63.92	
Washington	50.00	46.80	35.00	41.72	50.00	45.36	42.14	72.00	54.52	
Oregon	39.20	59.69	40.32	24.96	33.93	64.00	40.42	56.35	49.50	
California	44.25	48.00	25.48	36.00	42.40	51.45	52.25	74.97	55.12	
General average	40.65	41.71	33.43	26.73	26.08	35.37	31.11	31.60	34.78	

Average farm price of potatoes per bushel in the United States December 1, 1892–1900, by States.

States and Territories.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	77	54	44	34	38	89	46	42	49	[See note, page 740.]
New Hampshire	85	63	47	32	47	90	49	46	53	
Vermont	68	48	44	26	29	70	42	36	40	
Massachusetts	83	76	65	48	57	90	63	57	66	
Rhode Island	85	79	72	45	54	97	64	50	70	
Connecticut	76	75	68	41	46	90	55	46	70	
New York	65	55	48	23	31	67	42	40	45	
New Jersey	75	75	62	34	36	78	61	51	60	
Pennsylvania	72	60	57	28	27	66	58	43	53	
Delaware	63	65	50	38	35	65	69	51	60	
Maryland	68	68	53	30	30	68	53	51	54	
Virginia	60	57	56	38	34	70	55	56	59	
North Carolina	61	60	60	55	43	64	62	66	65	
South Carolina	85	77	77	73	66	105	100	104	100	
Georgia	80	92	81	71	75	100	75	83	77	
Florida	75	117	75	100	84	120	120	124	106	
Alabama	76	88	88	81	75	94	83	87	82	
Mississippi	76	84	82	64	62	82	72	102	83	
Louisiana	77	83	83	72	76	85	75	81	79	
Texas	85	103	99	78	78	95	86	91	88	
Arkansas	70	64	53	51	53	84	55	71	57	
Tennessee	48	49	49	40	40	73	57	65	58	
West Virginia	58	59	57	42	31	65	54	52	51	
Kentucky	52	56	56	39	33	67	46	61	50	
Ohio	64	67	52	32	26	62	41	43	40	
Michigan	53	45	43	16	19	43	27	32	26	
Indiana	72	73	54	31	25	62	41	43	38	
Illinois	80	74	64	30	26	62	46	41	41	
Wisconsin	54	49	53	17	19	38	24	26	28	
Minnesota	48	46	51	14	21	31	25	25	30	
Iowa	75	65	69	19	22	47	30	23	37	
Missouri	77	57	52	25	31	63	44	40	35	
Kansas	88	79	68	42	27	55	51	45	48	
Nebraska	75	79	77	30	25	46	37	25	49	
South Dakota	55	59	74	26	20	32	28	27	36	
North Dakota	40	49	46	17	21	33	34	27	49	
Montana	60	69	48	48	32	40	55	53	53	
Wyoming	70	65	60	56	43	55	65	61	68	
Colorado	61	54	55	33	47	56	54	55	82	
New Mexico	80	67	80	63	68	78	78	68	114	
Utah	72	33	30	34	32	30	31	55	48	
Nevada	58	40	35	38	38	73	90	90	56	
Idaho	54	56	53	40	30	32	54	61	47	
Washington	50	39	28	28	40	28	39	50	47	
Oregon	56	47	36	39	39	40	47	49	45	
California	59	50	49	48	53	49	55	63	53	
General average	66.11	59.37	53.59	26.57	28.62	54.66	41.38	39.04	43.1	

Wholesale prices of potatoes per bushel in leading cities of the United States, 1897–1900.

Date.	Cincinnati.		Chicago.		Milwaukee.		St. Louis.	
	Per barrel.		Burbank, per bushel.		Per bushel.		Burbank, per bushel.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1897.								
January	$0.90	$1.10	$0.18	$0.27	$0.18	$0.25	$0.24	$0.32
February	....	....	.21	.26	.18	.25	.25	.30
March	....	....	.18	.25	.20	.25	.21	.30
April	....	....	.18	.25	.15	.25	.23	.30
May	1.00	4.75	.19	.20	.15	.25	.24	.28
June	2.25	3.00	.18	.38	.15	1.00	.27	.40
July	1.75	2.50	.23	.28	.20	1.00	....	....
August	1.75	2.50	....	....	.50	.70	.55	.58
September	1.85	2.35	.52	.58	.35	.50	.50	.65
October	1.50	2.00	.38	.52	.35	.45	.40	.60
November	1.75	2.25	.40	.55	.35	.55	.37	.58
December	2.00	2.50	.50	.62	.45	.55	.53½	.65
1898.								
January	2.00	2.25	.57	.62	.45	.55	.60	.68
February	....	....	.57	.64	.50	.60	.62	.68
March	....	....	.60	.67	.50	.60	.58	.70
April	....	....	.58	.66	.45	.75	.52½	.75

Wholesale prices of potatoes per bushel in leading cities of the United States, 1897–1900—Continued.

Date.	Cincinnati. Per barrel.		Chicago. Burbank, per bushel.		Milwaukee. Per bushel.		St. Louis. Burbank, per bushel.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1898.								
May	$2.80	$3.75	$0.60	$0.87	$0.50	$0.90	$0.60	$0.85
June	2.25	2.75	.32	.65	.35	.65	.55	.70
July	1.50	2.50	.44	.50	.35	.80	.40	.50
August	1.25	1.75	......	......	.35	.50	......	......
September	1.25	1.75	.32	.48	.30	.40	.35	.50
October	1.25	1.60	.29	.36	.25	.35	.35	.43
November	1.25	1.35	.29	.35	.25	.30	.30	.41
December	......	......	.30	.36	.25	.30	.33	.40
1899.								
January	......	......	.34	.38	.20	.35	.39½	.45
February	......	......	.34	.50	.20	.45	.42	.55
March	......	......	.48	.75	.30	.65	.53	.75
April	......	......	.49	.68	.40	.60	.56	.72
May	2.00	6.00	.33	.52	.20	.55	.40	.55
June	1.50	2.50	.34	.60	.15	.40	.42	.52
July	1.15	2.00	.28	.28	.20	.90	......	......
August	1.10	1.50	......	......	.20	.35	.25	.30
September	1.40	1.60	.30	.40	.20	.30	.32	.40
October	......	......	.26	.32	.18	.30	.32	.40
November	......	......	.31	.42	.18	.35	.33	.44
December	......	......	.35	.46	.25	.40	.43	.48
1900.	Per bushel.							
January	.45	.57	.42	.50	.25	.40	.43	.52
February	.45	.55	.40	.49	.25	.42	.43	.50
March	.43	.50	.33	.45	.25	.45	.35	.46
April	.32	.45	.26	.37	.20	.38	.27	.40
May	.33	.50	.27	.39	.20	.35	.30	.45
June	.35	.50	.31	.41	.20	.30	.36	.45
July	......	......	......	......	.20	.55	......	......
August	......	......	......	......	.30	.40	......	......
September	.40	.45	.30	.40	.28	.38	.32	.40
October	.32	.40	.25	.34	.23	.35	.32	.38
November	.38	.47	.29	.46	.23	.42	.33	.48
December	.40	.50	.40	.48	.30	.50	.45	.54
1901.								
January	.42	.50	.40	.49	.35	.50	.45	.54
February	.40	.48	.38	.43	.37	.50	.18	.20
March	.30	.47	.33	.42	.32	.45	.37	.43
April	.35	.45	.30	.42	.28	.45	.41	.45
May	.38	.75	.35	.60	.30	.60	.39	.53
June	.64	.90	.35	.78	.30	.70	.50	.80
July	......	......	......	......	.25	1.20	......	......
August	.95	1.10	.95	1.25	.75	1.35	......	......
September	.75	1.20	.56	1.07	.40	1.00	.70	1.40
October	.40	.75	.59	.68	.50	.75	.70	.75
November	.60	.95	.59	.82	.60	.80	.83	1.00
December	.78	.90	.75	.82	.65	.87	.83	.83

HAY.

There was an improvement in prices of hay in the year 1901 over former years, outside prices being reached during July and August.

Condition of hay crop in United States, monthly, 1886–1900.

Year.	Clover. June.	Clover. July.	Timothy. July.	Timothy. Aug.	Year.	Clover. June.	Clover. July.	Timothy. July.	Timothy. Aug.
1886	......	......	......	91.2	1894	87.8	80.2	77.3	75.6
1887	......	......	......	80.6	1895	82.8	73.9	70.8	69.9
1888	......	......	......	......	1896	88.4	83.7	84.8	87.5
1889	......	......	......	94.5	1897	96.0	......	......	......
1890	95.1	94.0	93.9	93.6	1898	......	......	......	99.8
1891	91.0	89.3	87.4	90.9	1899	......	......	......	86.7
1892	94.9	95.5	96.8	93.2	1900	......	......	......	79.9
1893	92.7	92.6	89.8	89.6	1901	......	......	......	84.1

Acreage, production, value, prices, and exports of hay of the United States, 1866–1900.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per ton Dec. 1.	Farm value Dec. 1.	Chicago prices of No. 1 timothy by carload lots.				Domestic exports, fiscal years beginning July 1.
						December.		May of following year.		
						Low.	High.	Low.	High.	
	Acres.	Tons.	Tons.	Dolls.	Dollars.	Dolls.	Dolls.	Dolls.	Dolls.	Tons.
1866	17,668,904	1.23	21,778,627	10.14	220,835,771	......	......	......	......	5,028
1867	20,020,554	1.31	26,277,000	10.21	268,300,623	......	......	......	......	5,645
1868	21,541,573	1.21	26,141,900	10.08	263,589,235	......	......	......	......	....
1869	18,591,281	1.42	26,420,000	10.18	268,933,048	......	......	......	......	6,723
1870	19,861,805	1.23	24,525,000	12.47	305,743,224	......	......	......	......	4,581
1871	19,009,052	1.17	22,239,400	14.30	317,939,799	......	......	......	......	5,266
1872	20,318,936	1.17	23,812,800	12.94	308,024,517	......	......	......	......	4,557
1873	21,894,084	1.15	25,085,100	12.53	314,241,037	......	......	......	......	4,889
1874	21,769,772	1.15	25,133,900	11.94	300,222,454	......	......	......	......	7,183
1875	23,507,964	1.19	27,873,600	10.78	300,377,839	......	......	......	......	7,528
1876	25,282,797	1.22	30,867,100	8.97	276,991,422	......	......	9.00	10.00	7,287
1877	25,367,708	1.25	31,629,300	8.37	264,879,796	9.50	10.50	9.75	10.75	9,514
1878	26,931,300	1.47	39,608,296	7.20	285,015,625	8.00	8.50	9.00	11.50	8,127
1879	27,484,991	1.29	35,493,000	9.32	330,804,494	14.00	14.50	14.00	15.00	13,739
1880	25,863,955	1.23	31,925,233	11.65	371,811,084	15.00	15.50	17.00	19.00	12,662
1881	30,888,700	1.14	35,135,064	11.82	415,131,366	16.00	16.50	15.00	16.50	10,570
1882	32,339,585	1.18	38,138,049	9.70	369,958,158	11.50	12.25	12.00	13.00	13,309
1883	35,515,948	1.32	46,864,009	8.19	383,834,451	9.00	10.00	12.50	17.00	16,908
1884	38,571,593	1.26	48,470,460	8.17	396,139,309	10.00	11.50	15.50	17.50	11,142
1885	39,849,701	1.12	44,731,550	8.71	389,752,873	11.00	12.00	10.00	12.00	13,390
1886	36,501,688	1.15	41,796,499	8.46	353,437,699	9.50	10.50	11.00	12.50	13,873
1887	37,664,739	1.10	41,454,458	9.97	413,440,283	13.50	14.50	17.00	21.00	18,198
1888	38,591,903	1.21	46,643,094	8.76	408,499,565	11.00	11.50	10.50	11.00	21,928
1889	52,947,236	1.26	66,829,612	7.04	470,374,948	9.00	10.00	9.00	14.00	36,274
1890	50,712,513	1.19	60,197,589	7.87	473,569,972	9.00	10.50	12.50	15.50	28,066
1891	51,044,490	1.19	60,817,771	8.12	494,113,616	12.50	15.00	13.50	14.00	35,201
1892	50,853,061	1.18	59,823,735	8.20	490,427,798	11.00	11.50	12.00	13.50	33,084
1893	49,613,469	1.33	65,766,158	8.68	570,882,872	10.00	10.50	10.00	10.50	54,446
1894	48,321,272	1.14	54,874,408	8.54	468,578,321	10.00	11.00	10.00	10.25	47,117
1895	44,206,453	1.06	47,078,541	8.35	393,185,615	12.00	12.50	11.50	12.00	59,052
1896	43,259,756	1.37	59,282,158	6.55	388,145,614	8.00	8.50	8.50	9.00	61,658
1897	42,426,770	1.43	60,664,876	6.62	401,390,728	8.00	8.50	9.50	10.50	81,827
1898	42,780,827	1.55	66,376,920	6.00	398,060,647	8.00	8.25	9.50	10.50	64,916
1899	41,328,462	1.35	56,655,756	7.27	411,926,187	10.50	11.50	10.50	12.50	72,716
1900	39,132,890	1.28	50,110,906	8.89	445,538,870	11.50	14.00	12.00	13.50	89,864
1901	[See note under Potatoes, page 740.]					12.50	13.90	......	......	....

Acreage, production, and value of hay in the United States in 1901, by States.

[See note under Potatoes, p. 740.]

Average yield per acre of hay in the United States, 1892–1900, by States.

States and Territories.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Maine	0.90	0.92	0.95	1.02	1.00	1.10	1.20	0.90	0.90	[See note under Potatoes, p. 740.]
New Hampshire	.90	1.06	.95	.95	.96	1.15	1.25	.89	.87	
Vermont	.95	1.11	1.20	1.07	1.25	1.30	1.45	1.14	1.24	
Massachusetts	1.10	1.15	1.26	1.11	1.28	1.40	1.42	1.13	.97	
Rhode Island	.90	.83	.75	.91	1.10	1.15	1.18	.89	.92	
Connecticut	1.00	.99	.87	.85	1.07	1.20	1.31	.94	.89	
New York	1.10	1.24	1.17	.73	.81	1.35	1.40	1.04	.81	
New Jersey	1.07	.99	1.16	1.21	1.15	1.75	1.42	.83	1.26	
Pennsylvania	1.10	1.03	1.18	1.01	1.06	1.40	1.45	1.20	1.10	
Delaware	1.00	.75	1.30	1.23	1.10	1.35	1.38	1.04	.98	
Maryland	.98	1.04	1.03	1.25	.87	1.35	1.20	1.13	1.09	
Virginia	.95	1.11	.72	1.13	1.08	1.08	1.32	1.10	1.16	
North Carolina	1.20	1.70	1.45	1.63	1.26	1.25	1.70	1.50	1.41	
South Carolina	1.20	1.57	1.53	1.00	1.33	1.00	1.60	1.22	1.32	
Georgia	1.35	1.32	1.16	1.60	1.38	1.35	1.75	1.45	1.69	
Florida	......	2.00	1.23	1.53	1.40	1.00	1.60	1.46	1.20	
Alabama	1.30	1.52	2.68	1.56	1.40	1.45	1.90	1.66	1.85	
Mississippi	1.35	1.65	1.84	1.95	1.35	1.48	1.90	1.44	1.75	
Louisiana	1.40	1.62	1.96	2.02	1.90	1.90	2.10	1.95	2.00	
Texas	1.05	1.04	1.33	1.48	1.00	1.40	1.50	1.43	1.80	
Arkansas	1.15	1.17	1.32	1.20	1.18	1.30	1.54	1.48	1.63	
Tennessee	1.10	1.39	1.18	1.39	1.40	1.45	1.50	1.31	1.40	
West Virginia	1.00	1.10	1.02	.71	1.22	1.35	1.54	1.29	1.18	
Kentucky	1.15	1.33	1.26	1.35	1.20	1.17	1.45	1.29	1.40	
Ohio	1.15	1.33	1.27	.58	1.26	1.44	1.39	1.30	1.06	
Michigan	1.20	1.46	1.20	.58	1.16	1.49	1.36	1.22	1.29	

Average yield per acre of hay in the United States, 1892–1900, by States—Continued.

States and Territories.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Indiana	1.20	1.36	1.27	0.61	1.30	1.43	1.45	1.34	1.21	[See note under Potatoes, page 740.]
Illinois	1.25	1.21	1.14	.66	1.38	1.29	1.56	1.29	1.27	
Wisconsin	1.20	1.52	1.31	.88	1.25	1.35	1.50	1.47	1.15	
Minnesota	1.25	1.62	1.02	1.30	1.69	1.57	1.80	1.70	1.16	
Iowa	1.25	1.58	.73	1.08	1.74	1.50	1.75	1.34	1.42	
Missouri	1.15	1.24	.85	1.17	1.43	1.15	1.60	1.37	1.29	
Kansas	1.10	1.31	.77	1.24	1.42	1.30	1.46	1.57	1.32	
Nebraska	1.20	1.25	.59	.99	1.66	1.60	1.60	1.66	1.38	
South Dakota	1.25	1.42	.94	.79	1.28	1.25	1.38	1.43	1.18	
North Dakota	1.30	1.29	1.19	1.42	1.65	1.60	1.50	1.58	.92	
Montana	1.10	1.26	1.20	.94	1.38	1.50	1.45	1.42	1.60	
Wyoming	1.15	1.35	1.60	1.08	1.55	1.65	1.96	1.47	1.68	
Colorado	2.00	1.19	2.27	2.42	2.20	2.25	2.20	2.10	2.28	
New Mexico	1.20	2.08	1.88	2.61	3.00	3.50	3.75	1.70	2.06	
Arizona	1.30	1.75	1.82	1.85	3.20	3.00	3.50	2.63	2.31	
Utah	1.40	1.72	2.52	2.56	2.70	2.95	3.25	2.50	2.65	
Nevada	1.75	2.66	4.04	3.01	2.55	2.50	2.60	1.87	2.43	
Idaho	1.50	2.45	2.53	2.57	2.60	2.30	3.75	2.50	2.80	
Washington	1.40	1.58	2.05	1.85	1.95	2.25	1.75	2.02	2.16	
Oregon	1.45	1.88	2.00	1.78	1.98	1.90	1.90	1.97	2.35	
California	1.50	1.69	1.93	1.66	1.65	1.60	1.60	1.63	1.51	
General average	1.18	1.33	1.14	1.06	1.37	1.43	1.55	1.35	1.28	

Average value per acre of hay in the United States, 1892–1900, by States.

States and Territories.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
Maine	$11.52	$11.16	$9.12	$9.87	$10.25	$10.73	$9.12	$9.09	$11.66	[See note under Potatoes, page 740.]
New Hampshire	11.88	16.54	9.97	11.88	12.38	13.23	11.56	10.46	13.48	
Vermont	9.50	11.80	11.93	13.11	12.85	12.03	9.21	10.55	13.70	
Massachusetts	18.26	19.93	19.53	19.42	20.99	19.46	17.18	17.52	16.88	
Rhode Island	15.66	16.27	12.25	15.70	18.26	16.67	14.93	15.35	17.20	
Connecticut	16.50	17.32	13.54	13.68	15.74	15.60	14.61	13.63	14.89	
New York	12.10	14.05	11.30	10.00	9.75	11.14	8.05	10.87	11.88	
New Jersey	15.25	17.26	16.34	15.29	16.50	18.81	13.63	12.74	20.22	
Pennsylvania	13.53	14.83	13.35	12.42	12.88	12.81	11.46	13.80	15.29	
Delaware	12.83	12.75	19.50	14.96	14.30	13.50	11.66	12.12	13.67	
Maryland	11.52	14.82	11.46	14.44	10.31	14.17	11.16	13.73	15.81	
Virginia	10.92	14.53	8.56	12.92	11.03	11.07	11.22	11.27	15.43	
North Carolina	12.66	18.89	15.85	16.53	13.55	12.19	15.81	15.15	15.79	
South Carolina	13.56	15.18	16.45	7.62	15.06	11.50	15.20	12.56	15.18	
Georgia	15.93	15.92	14.36	17.44	15.25	17.55	20.56	19.07	21.55	
Florida	16.38	39.50	19.99	20.24	18.20	14.25	22.56	22.41	16.44	
Alabama	14.04	17.08	25.49	15.93	13.72	13.86	17.57	18.92	19.52	
Mississippi	13.38	15.86	17.79	18.91	12.77	14.06	15.96	13.32	17.41	
Louisiana	13.72	14.58	28.85	19.47	16.63	16.62	19.74	18.92	18.80	
Texas	8.99	9.98	10.13	9.52	7.20	10.15	8.77	10.15	12.24	
Arkansas	10.05	10.96	11.66	11.12	8.90	11.25	10.39	12.80	14.43	
Tennessee	11.44	14.96	13.30	15.05	13.54	15.59	14.25	14.74	16.52	
West Virginia	10.50	14.02	10.87	9.04	11.94	11.95	12.94	12.19	15.81	
Kentucky	10.92	13.51	13.19	14.77	11.35	11.70	13.19	13.42	15.89	
Ohio	10.55	13.37	10.74	7.40	9.99	9.00	7.09	11.63	11.71	
Michigan	10.08	13.37	10.85	7.59	9.84	11.55	9.72	10.37	12.19	
Indiana	9.36	12.46	9.63	7.34	9.33	8.44	8.12	10.45	11.80	
Illinois	9.41	10.72	9.50	6.77	8.82	7.93	9.20	10.00	10.67	
Wisconsin	9.18	10.94	10.42	8.47	8.25	8.44	8.62	10.07	11.10	
Minnesota	5.75	7.40	5.41	6.66	6.41	7.06	6.66	7.40	8.06	
Iowa	6.56	9.73	5.39	6.97	6.94	6.37	7.09	7.10	9.66	
Missouri	7.76	8.73	6.65	7.96	6.94	7.07	9.28	8.56	8.97	
Kansas	4.84	6.14	4.04	4.04	3.83	4.42	4.74	5.49	6.01	
Nebraska	5.12	6.09	4.20	3.52	4.05	4.80	5.28	6.14	7.11	
South Dakota	4.25	5.21	4.02	2.60	3.99	3.69	4.14	4.43	4.66	
North Dakota	5.33	4.80	4.61	4.94	5.59	5.20	4.87	5.21	5.20	
Montana	9.85	9.94	8.60	10.72	9.47	11.63	9.86	10.93	13.92	
Wyoming	7.36	10.80	16.10	7.02	11.07	9.90	11.40	9.70	12.26	
Colorado	13.00	8.31	17.12	14.21	13.68	12.38	11.88	15.43	16.95	
New Mexico	13.50	17.68	21.62	20.88	17.10	24.50	27.56	18.02	20.39	
Arizona	13.65	14.44	21.84	16.65	28.00	15.00	42.00	27.22	26.10	
Utah	8.83	8.89	14.01	13.49	13.50	14.01	14.62	17.75	21.07	
Nevada	12.25	26.60	29.29	20.32	12.29	12.50	18.20	14.31	18.71	
Idaho	11.10	13.48	10.98	16.06	12.25	12.08	18.37	15.75	18.20	
Washington	12.60	14.49	15.13	12.49	13.83	20.25	13.30	17.98	20.52	
Oregon	12.98	15.23	11.72	10.89	13.07	14.73	13.78	13.49	15.98	
California	13.14	13.30	18.34	11.72	10.48	14.40	22.80	13.04	12.81	
General average	9.64	11.51	9.70	8.89	8.97	9.46	9.80	9.97	11.89	

Average farm price of hay per ton in the United States, December 1, 1892–1900, by States.

States and Territories.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
Maine	$12.80	$12.13	$9.60	$9.68	$10.25	$9.75	$7.60	$10.10	$12.95	-
New Hampshire	13.20	15.60	10.50	12.50	12.90	11.50	9.25	11.75	15.50	
Vermont	10.00	10.63	9.94	12.25	10.28	9.25	6.35	9.25	11.05	
Massachusetts	16.60	17.33	15.50	17.50	16.40	13.90	12.10	15.50	17.40	
Rhode Island	17.40	19.60	16.33	17.25	16.60	14.50	12.65	17.25	18.70	
Connecticut	16.50	17.50	15.56	16.10	14.71	13.00	11.15	14.50	16.73	
New York	11.00	11.33	9.66	13.70	12.04	8.25	5.75	10.45	14.05	
New Jersey	14.25	17.43	14.09	12.64	14.35	10.75	9.60	15.35	16.05	
Pennsylvania	12.30	14.40	11.31	12.30	12.15	9.15	7.90	11.50	13.90	
Delaware	12.33	17.00	15.00	12.16	13.00	10.00	8.45	11.65	13.95	
Maryland	11.75	14.25	11.13	11.55	11.85	10.50	9.30	12.15	14.05	
Virginia	11.50	13.09	11.89	11.43	10.21	10.25	8.50	10.25	13.30	
North Carolina	10.55	11.11	10.93	10.14	10.75	9.75	9.30	10.10	11.20	
South Carolina	11.30	9.67	10.75	7.62	11.32	11.50	9.50	10.30	11.50	
Georgia	11.80	12.06	12.38	10.90	11.05	13.00	11.75	13.15	12.75	
Florida	14.00	19.75	16.25	13.23	13.00	14.25	14.10	15.35	13.70	
Alabama	10.80	11.24	9.51	10.21	9.80	10.25	9.25	11.40	10.55	
Mississippi	9.91	9.61	9.67	9.70	9.46	9.50	8.40	9.25	9.95	
Louisiana	9.80	9.00	10.64	9.64	8.75	8.75	9.40	9.70	9.40	
Texas	8.56	9.60	7.62	6.43	7.20	7.75	5.85	7.10	6.80	
Arkansas	8.74	9.37	8.83	9.27	7.54	8.65	6.75	8.65	8.85	
Tennessee	10.40	10.76	11.27	10.83	9.67	10.75	9.50	11.25	11.80	
West Virginia	10.50	12.25	10.66	12.73	9.79	8.85	8.40	9.45	13.40	
Kentucky	9.50	10.16	10.47	10.94	9.46	10.00	9.10	10.40	11.35	
Ohio	9.17	10.05	8.46	12.76	7.93	6.25	5.75	8.95	11.05	
Michigan	8.40	9.16	9.04	13.09	8.48	7.75	7.15	8.50	9.45	
Indiana	7.80	9.16	7.58	12.03	7.18	5.90	5.60	7.80	9.75	
Illinois	7.53	8.86	8.33	10.25	6.39	6.15	5.90	7.75	8.40	
Wisconsin	7.65	7.20	7.96	9.63	6.60	6.25	5.75	6.85	9.65	
Minnesota	4.60	4.57	5.30	5.12	3.79	4.50	3.70	4.35	6.95	
Iowa	5.25	6.16	7.39	6.45	3.99	4.25	4.05	5.30	6.80	
Missouri	6.75	7.04	7.82	6.80	4.85	6.15	5.80	6.25	6.95	
Kansas	4.40	4.69	5.25	3.26	2.70	3.40	3.25	3.50	4.55	
Nebraska	4.27	4.87	7.12	3.56	2.44	3.00	3.30	3.70	5.15	
South Dakota	3.40	3.67	4.28	3.29	3.12	2.95	3.00	3.10	3.95	
North Dakota	4.10	3.72	3.87	3.48	3.39	3.25	3.25	3.30	5.65	
Montana	8.95	7.89	7.17	11.40	6.86	7.75	6.80	7.70	8.70	
Wyoming	6.40	8.00	10.00	6.50	7.14	6.00	5.90	6.60	7.30	
Colorado	6.50	6.98	7.54	5.87	6.22	5.50	5.40	7.35	7.60	
New Mexico	11.25	8.50	11.50	8.00	5.70	7.00	7.35	10.60	9.90	
Arizona	10.50	8.25	12.00	9.00	8.75	5.00	12.00	10.85	11.30	
Utah	6.31	5.17	5.56	5.27	5.00	4.75	4.50	7.10	7.95	
Nevada	7.00	10.00	7.25	6.75	4.82	5.00	7.00	7.65	7.70	
Idaho	7.40	5.50	4.34	6.25	4.71	5.25	4.90	6.30	6.50	
Washington	9.00	9.17	7.38	6.75	7.09	9.00	7.60	8.90	9.50	
Oregon	8.92	8.10	5.86	6.12	6.60	7.75	7.25	6.85	6.80	
California	8.76	7.87	9.50	7.06	6.35	9.00	14.25	8.00	8.15	
General average	8.49	8.68	8.54	8.35	6.55	6.62	6.00	7.27	8.89	

[See note under Potatoes, page 740.]

Wholesale prices of hay (baled) in leading cities of the United States, 1897–1901.

Date.	New York. No. 1, per hundredweight.		Chicago. No. 1 Timothy, per ton.		Cincinnati. No. 1 Timothy, per ton.		St. Louis. No. 1 Timothy, per ton.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1897.								
January	$0.75	$0.85	$8.00	$8.50	$10.00	$10.50	$9.50	$11.00
February	.77½	.80	7.50	8.00	10.00	10.50	9.00	11.00
March	.80	.80	8.00	8.50	10.00	11.50	9.00	12.00
April	.77½	.85	8.00	8.50	10.50	11.50	11.00	14.00
May	.80	.82½	8.50	9.00	11.00	11.50	11.50	13.75
June	.75	.80	8.50	9.00	9.50	11.00	9.25	12.75
July	.77½	.80	8.50	9.00	9.00	11.00	9.50	12.50
August	.75	.90	8.50	9.00	8.00	9.25	8.50	11.00
September	.72½	.80	8.50	9.00	8.00	8.75	8.50	10.00
October	.75	.80	8.00	8.50	8.00	8.25	9.00	10.50
November	.75	.80	8.00	8.50	8.00	9.00	9.00	10.50
December	.75	.80	8.00	8.50	8.50	9.00	9.75	11.00
1898.								
January	.72½	.80	8.00	8.50	8.50	9.00	8.25	9.50
February	.72½	.75	8.00	8.50	8.00	9.00	8.50	9.50
March	.75	.80	9.00	9.50	8.00	9.00	9.00	10.00
April	.75	.80	8.50	9.00	8.50	10.00	9.00	12.50
May	.80	.80	9.50	10.50	9.00	10.25	10.50	12.00
June	.77½	.80	9.00	9.50	8.25	9.00	10.50	11.50
July	.77½	.77½	8.00	8.50	8.25	9.00	9.00	10.00
August	.70	.77½	8.00	8.50	7.50	9.00	7.00	10.00
September	.65	.70	7.50	8.00	7.50	8.00	7.00	8.00
October	.65	.67½	7.50	8.00	7.75	8.25	7.00	8.50
November	.65	.65	8.00	8.50	8.00	8.00	7.50	8.50
December	.65	.67½	8.00	8.25	8.00	8.25	7.50	8.50
1899.								
January	.65	.65	7.50	9.00	7.75	8.50	8.00	9.90
February	.65	.65	7.75	8.50	8.00	8.75	8.00	8.75
March	.65	.67½	8.50	10.00	9.00	11.00	8.00	10.00
April	.67½	.75	9.50	10.50	10.50	11.50	9.00	11.00
May	.75	.90	9.50	10.50	10.50	11.00	10.50	11.50
June	.80	.95	10.00	11.50	10.50	12.00	10.50	11.50
July	.85	.95	10.00	13.00	9.00	12.50	10.00	12.00
August	.87½	.95	9.00	13.00	9.00	10.50	8.00	12.00
September	.80	.90	9.50	11.50	9.00	11.25	8.00	10.50
October	.80	.92½	9.50	11.00	11.00	12.00	9.50	10.50
November	.80	.87½	10.50	11.50	11.50	13.00	10.00	10.75
December	.87½	.87½	10.50	11.50	12.00	13.00	10.00	11.50
1900.								
January	.87½	.87½	10.00	11.50	13.00	14.00	11.00	12.50
February	.87½	.87½	10.50	11.50	13.50	14.00	10.50	12.00
March	.87½	.90	10.50	11.50	13.75	14.25	11.00	12.50
April	.90	.90	10.50	14.00	14.50	15.00	11.50	13.00
May	.90	.95	10.50	12.50	14.25	15.00	11.00	13.50
June	.90	.92½	10.00	11.50	14.00	14.75	10.50	13.50
July	.90	.95	10.50	12.50	13.75	15.00	11.00	14.50
August	.90	.97½	11.00	12.50	11.50	15.00	9.75	13.00
September	.90	.95	11.00	12.00	12.50	13.75	10.00	12.00
October	.95	.95	11.00	12.00	13.50	14.50	11.00	12.50
November	.92½	.95	11.50	13.50	13.50	14.00	10.75	13.50
December	.90	.95	11.50	14.00	13.75	14.25	11.50	14.00
1901.								
January	.95	.95	11.50	14.00	14.00	14.50	11.50	13.50
February	.90	.97½	11.50	13.50	13.75	14.25	11.50	12.75
March	.92½	.97½	12.50	14.00	13.50	15.00	11.50	14.00
April	.95	.97½	12.50	14.00	13.75	15.00	12.50	14.50
May	.92½	1.00	12.00	13.50	13.75	14.25	12.00	14.50
June	.90	.92½	12.00	13.00	12.00	14.25	12.00	15.50
July	.87½	.95	12.00	15.00	11.50	15.50	12.50	17.50
August	.90	.95	12.00	15.00	11.75	14.50	13.00	16.00
September	.87½	.95	12.00	14.00	12.50	13.25	12.50	15.50
October	.92½	.92½	12.00	13.50	12.50	13.25	12.50	14.50
November	.90	.92½	12.00	13.50	12.50	13.25	13.00	14.50
December	.95	.95	12.50	13.90	13.00	14.00	13.50	15.00

COTTON.

Beginning with September 1, 1900, and ending with August 31, 1901, the commercial movement of the cotton crop from the States and Territories of production, together with the takings of the mills located in those States, amounted to 10,401,453 bales, approximating an average gross weight of 513 pounds per bale. With the exception of two years, 1897–98 and 1898–99, this was the largest crop on record. Of this amount it is estimated that the United States consumed 3,588,500 bales and foreign countries imported 6,639,931 bales. Among the noteworthy features of the crop was the unprecedented yield in the State of Texas, which exceeded by 163,540 bales that of 1898–99, when the crop was the largest on record, and the increase in the number of small round-lap bales marketed during the season.

In the Department's Report on the Cotton Crop for the year 1898–99, attention was called to the fact that for the first time the United States had taken the lead of all other countries in the consumption of raw cotton. It still holds the supremacy, although the consumption in 1900–1901 was not quite so great as the previous year; and the indications are that it will continue to hold this position for an indefinite time, as the increase in the spinning capacity of its mills in recent years has been far greater than that of any other country, and even much greater than that of all the countries of Europe combined.

Another feature of the year worthy of notice was the wide range of prices during the last eight months of the season. On September 1, 1900, the market for spot cotton opened in New York at $9\frac{5}{8}$ cents a pound for middling upland, and on January 28 it had advanced to 12 cents, the highest price attained for many years, but toward the close of the season (August 5) declined to 8 cents a pound—a difference of 4 cents. The New Orleans market opened September 1, 1900, at $9\frac{5}{8}$ cents a pound for middling upland, and during the month advanced to $11\frac{1}{8}$ cents, the highest price reached during the season, the lowest being $7\frac{9}{16}$, on May 15. Unlike the previous year, the highest prices were obtained during the first five months of the season, while the crop was under the control of the planters.

Although the crop was nearly 790,000 bales less than that of 1898–99—the greatest crop on record—it was worth more than that crop by $205,631,000, its total value being $511,098,111. The value of the cotton crop to the country is further illustrated in the exports, which amounted in the fiscal year ending June 30, 1901, to $313,673,443. This is $38,078,969 more than the value of all breadstuffs exported during the same period, and $67,740,258 more, if the exports of the by-products of the crop are included, the value of the cotton oil being $16,541,321 and cotton oil cake and meal being $13,119,968.

In estimating the crop of the States and Territories, the Department has followed its usual method, the statistical data used being furnished by the officials of the rail and water lines that have transported cotton from the States of production, by the officials of the mills located in those States, and by special agents of the Department at the Southern ports and important receiving points in the interior. The reports from these sources are condensed in the following table, so as to show the number of bales of cotton moved from each State and Territory to the ports, to Northern and Western mills, to Canada, and all other foreign destinations; the number taken from the current crop by the mills; the number forwarded from one cotton State to the markets and mills of another; and the number taken by the mills from the ports.

In the table which follows, "Taken from other States" includes all cotton forwarded by rail, water, and wagon from interior points and plantations of one State to interior markets of another; also all cotton shipped from interior points of one State to the mills of another—all of which is first credited to the State in which it originated. In further explanation of the large amount of cotton "Taken from other States," it may be stated that at points like Augusta and Columbus, Ga., there are large deliveries of cotton by rail, water, and wagon from adjacent plantations in South Carolina and Alabama. There are also considerable deliveries from Alabama plantations at Columbus and Meridian, Miss., and from Indian Territory plantations at Denison and Gainesville, Tex., and from Oklahoma plantations at Quanah and Vernon, Tex. At Shreveport, La., the receipts from Texas and Arkansas are very large. Moreover, the mills of nearly all the cotton States obtain supplies from other States at some time or another during the year. Hence, such movements from one State into another are deducted; otherwise there would be a duplication.

"Taken from ports" includes only the cotton purchased at the ports by mills situated in the cotton States, and which has already been counted in the movement to the ports.

The total movement of the crop is 1,505,270 bales greater than in 1899–1900, while the amount taken by Southern mills is only 5,820 bales greater.

The amount "Taken from other States" is 233,679 bales, and from ports, 18,799 bales in excess of the previous year.

The cotton produced in Kansas was sent by rail to St. Louis and that in Kentucky was shipped by river steamers to the same market. The few bales produced in Utah were used in one of the local mills.

The total commercial crop is shown to be 1,258,612 bales greater than in 1899-1900. All round bales of light weight, that is, bales weighing about 250 pounds, are counted as half bales.

Cotton crop of 1900-1901.

[In commercial bales.]

States and Territories.	Movement and mill purchases.			Taken from other States and ports.			Total crop.
	Forwarded by rail, etc.	Bought by mills.	Total.	Taken from other States.	Taken from ports.	Total.	
Alabama	914,790	157,832	1,072,622	42,429	8,348	50,777	1,021,845
Arkansas	886,442	1,731	888,173	32,623	22	32,645	855,528
Florida	50,163	....	50,163	1	....	1	50,162
Georgia	1,122,935	356,878	1,479,813	198,175	10,065	208,240	1,271,573
Indian Territory	218,975	....	218,975	809	....	809	218,166
Kansas	140	....	140	....	....	....	140
Kentucky	133	23,227	23,360	23,227	....	23,227	133
Louisiana	884,140	16,694	900,834	172,224	16,694	188,918	711,916
Mississippi	1,111,290	24,424	1,135,714	54,438	21	54,459	1,081,255
Missouri	26,953	4,261	31,214	4,261	....	4,261	26,953
North Carolina	304,801	408,333	713,134	139,532	19,570	159,102	554,032
Oklahoma	121,900	....	121,900	458	....	458	121,442
South Carolina	453,244	501,290	954,534	207,157	4,083	211,240	743,294
Tennessee	200,861	33,305	234,166	24,844	3,307	28,151	206,015
Texas	3,561,180	12,349	3,573,529	46,880	....	46,880	3,526,649
Utah	....	32	32	....	....	....	32
Virginia	12,318	36,462	48,780	36,462	....	36,462	12,318
United States	9,870,265	1,576,818	11,447,083	983,520	62,110	1,045,630	10,401,453

Value of the crop of 1900-1901.

States and Territories.	Upland crop.				Sea-island crop.				Total value.
	Production.	Weight per bale.	Price per pound.	Value.	Production.	Weight per bale.	Price per pound.	Value.	
	Bales.	*Lbs.*	*Cents.*	*Dollars.*	*Bales.*	*Lbs.*	*Cents.*	*Dollars.*	*Dollars.*
Alabama	1,021,845	513	9.41	49,327,830	....	....	....	....	49,327,830
Arkansas	855,528	503	9.62	41,397,802	....	....	....	....	41,397,802
Florida	24,788	498	9.49	1,171,486	25,374	392	20.0	1,989,322	3,160,808
Georgia	1,216,599	498	9.49	57,496,712	54,974	392	20.0	4,309,962	61,806,674
Indian Territory	218,166	531	9.45	10,947,461	....	....	....	....	10,947,461
Kansas	140	500	9.62	6,731	....	....	....	....	6,734
Kentucky	133	500	9.62	6,397	....	....	....	....	6,397
Louisiana	711,916	516	9.60	35,265,471	....	....	....	....	35,265,471
Mississippi	1,081,255	516	9.60	53,561,048	....	....	....	....	53,561,048
Missouri	26,953	503	9.62	1,304,218	....	....	....	....	1,304,218
North Carolina	554,032	477	9.62	25,423,088	....	....	....	....	25,423,088
Oklahoma	121,442	531	9.62	6,203,525	....	....	....	....	6,203,525
South Carolina	734,917	485	9.44	33,647,440	8,377	358	26.0	779,731	34,427,171
Tennessee	206,015	503	9.61	9,958,415	....	....	....	....	9,958,415
Texas	3,526,649	531	9.49	177,714,544	....	....	....	....	177,714,544
Utah	32	500	9.62	1,539	....	....	....	....	1,539
Virginia	12,318	494	9.62	585,386	....	....	....	....	585,386
United States	10,312,728	513	9.52	504,019,096	88,725	389	20.5	7,079,015	511,098,111

Cost of picking the cotton crops of 1899–1900 and 1900–1901.

States and Territories.	1899-1900. Pounds of seed cotton.	1899-1900. Cost per 100 pounds.	1899-1900. Total cost.	1900-1901. Pounds of seed cotton.	1900-1901. Cost per 100 pounds.	1900-1901. Total cost.
	Thousands of pounds.	*Cents.*	*Dollars.*	*Thousands of pounds.*	*Cents.*	*Dollars.*
Alabama	1,441,619	36	5,189,828	1,495,981	43	6,432,718
Arkansas	953,874	43	4,101,658	1,226,827	56	6,870,231
Florida—upland	17,086	46	78,596	35,174	51	179,387
Florida, sea-island	.....	.....	.....	28,698	98	281,240
Georgia—upland	1,792,311	38	6,810,782	1,726,354	42	7,250,687
Georgia, sea-island	.....	.....	.....	62,176	87	540,931
Indian Territory	178,109	51	908,356	331,176	71	2,351,350
Louisiana	1,015,639	40	4,062,556	1,048,652	53	5,557,856
Mississippi	1,747,829	39	6,816,533	1,592,689	45	7,167,100
Missouri	24,617	50	123,085	38,651	58	224,176
North Carolina	702,836	36	2,530,210	751,267	43	3,230,448
Oklahoma	98,834	58	573,237	184,349	75	1,382,618
South Carolina—upland	1,152,842	38	4,380,800	1,014,085	40	4,056,740
South Carolina—sea-island	.....	.....	.....	8,620	120	103,440
Tennessee	273,975	46	1,260,285	295,426	51	1,506,673
Texas	3,621,254	44	15,933,518	5,353,453	66	35,332,790
Virginia	11,386	37	42,128	17,331	37	64,125
United States	13,032,211	40.5	52,811,572	15,211,009	54.3	82,532,510

Progress of cotton spinning in the cotton States.

States.	No. of spindles. 1900.	No. of spindles. 1901.	No. of mills in operation. 1897-98.	1898-99.	1899-1900.	1900-1901.	New mills, 1901. Completed, etc.	Projected.	Total.
Alabama	437,200	550,966	37	38	44	49	8	11	19
Arkansas	17,160	14,660	2	3	4	4	1	2	3
Georgia	969,364	1,016,258	77	79	86	107	28	14	42
Kansas	2,000	.....	.....	.....	1	.....	.....	.....	.....
Kentucky	68,730	68,006	11	11	10	9	.....	3	3
Louisiana	62,222	62,652	3	3	5	5	2	.....	2
Mississippi	88,584	118,320	7	7	10	14	7	3	10
Missouri	15,744	15,794	3	3	4	3	.....	.....	.....
North Carolina	1,264,509	1,428,066	161	169	190	218	29	16	45
South Carolina	1,693,649	1,908,692	76	80	93	115	20	13	33
Tennessee	155,997	196,761	29	29	32	33	6	1	7
Texas	60,876	51,076	4	5	6	9	4	6	10
Virginia	165,452	159,532	15	17	15	15	2	2	4
Total	5,001,487	5,590,783	425	444	500	581	107	71	178

Cotton acreage from 1895 to 1900, inclusive.

[See note under Potatoes, page 740.]

Cotton crops from 1895–96 to 1900–1901, inclusive.

[See note under Potatoes, page 740.]

Exports of cotton from United States to foreign countries.

[In bales of 500 pounds.]

Countries.	Year ended June 30, 1899.		Year ended June 30, 1900.		Year ended June 30, 1901.	
	Bales.	Value.	Bales.	Value.	Bales.	Value.
Austria-Hungary	57,127	$1,576,175	44,919	$1,758,164	37,042	$1,685,220
Belgium	129,525	3,599,471	148,319	5,680,303	151,063	7,302,960
Denmark	39,249	1,078,300	31,990	1,251,325	26,395	1,177,048
France	803,406	21,946,691	736,092	27,729,378	729,332	34,954,658
Germany	1,728,975	47,346,679	1,619,173	63,476,825	1,601,462	76,234,319
Greece	....	....	400	18,200	100	4,700
Italy	417,353	11,652,768	443,951	17,441,121	361,627	16,825,300
Netherlands	51,621	1,401,040	74,635	2,818,248	51,919	2,422,092
Portugal	21,627	612,132	18,472	723,774	13,102	631,997
Russia	95,011	2,796,793	54,950	2,258,026	51,928	2,498,823
Spain	248,635	7,194,000	246,612	9,618,930	239,104	11,204,979
Sweden and Norway	23,624	703,503	14,773	597,244	12,416	599,771
United Kingdom	3,609,444	99,709,352	2,302,128	90,202,651	3,022,112	147,158,409
Dominion of Canada	98,230	2,994,674	109,982	4,207,463	102,309	5,104,197
Mexico	36,130	1,043,473	18,522	814,231	34,104	1,750,674
West Indies (French)	5	187	2	84	5	238
Chinese Empire	4,060	131,734	11,215	460,385	....	....
East Indies (British)	9	308	1,601	55,265	350	16,100
Hongkong	56	1,710	....	....	....	....
Japan	182,734	5,775,784	323,203	12,712,619	73,722	4,086,317
All other countries	....	....	227	8,501	358	15,641
Total	7,546,821	209,564,771	6,201,166	241,832,737	6,508,450	313,673,443

Imports of raw cotton into the United States, 1897 to 1901.

Countries.	1897.	1898.	1899.	1900.	1901.
France	....	....	....	30	....
Germany	23,460	26,039	....	13,401	100
Russia (on Black Sea)	....	....	....	....	1,625
United Kingdom	13,236,695	12,594,972	10,562,308	10,478,611	6,980,173
Newfoundland and Labrador	....	....	....	40,120	....
Quebec, Ontario, Manitoba, etc	31,219	50,842	34,849	....	90,950
British Columbia	....	5	50,492	....	....
Nicaragua	....	....	....	3,494	....
Mexico	2,500	13,167	178,352	....	92,889
West Indies (British)	1,700	....	1,241	500	2,885
Haiti	12,992	....	....	60	....
Brazil	....	....	....	583	....
Chile	24,175	4,240	....	69,471	17,822
Colombia	....	....	....	29,549	....
Ecuador	4,321	....	25,731	25,000	5,446
Peru	880,154	1,296,236	1,501,498	2,787,265	4,103,863
China	64,383	66,321	....	3,150	178,522
East Indies (British)	40,080	29,612	189,801	217,323	196,273
East Indies (Dutch)	18,040	32,183	....	....	171,542
Hongkong	8,571	....	....	....	....
Japan	2,213	....	....	....	1,410
Australasia (British)	....	259,818	97,125	141,185	52,601
Oceania (French)	230,774	48,367	10,696	34,193	....
Africa (British)	....	73,550	....	....	....
Egypt	37,323,249	38,165,061	37,506,062	53,554,586	34,735,682
Total in pounds	51,898,926	52,660,363	50,158,158	67,398,521	46,631,283
Total in bales of 500 pounds	103,798	105,321	100,316	134,797	93,263

Condition of cotton crop in the United States, monthly, 1886–1901.

Year.	June.	July.	August.	September.	October.	Year.	June.	July.	August.	September.	October.
1886	88.7	86.1	81.3	82.1	79.3	1894	88.3	89.6	91.8	85.9	82.7
1887	96.9	96.9	93.3	82.8	76.5	1895	81.0	82.3	77.9	70.8	65.1
1888	88.2	86.7	87.3	83.8	78.9	1896	97.2	92.5	80.1	64.2	60.7
1889	86.4	87.6	89.3	86.6	81.5	1897	83.5	86.0	86.9	78.3	70.0
1890	88.8	91.4	89.5	85.5	80.0	1898	89.0	91.2	91.2	79.8	75.4
1891	85.7	88.6	88.9	82.7	75.7	1899	85.7	87.8	84.0	68.5	62.4
1892	85.9	86.9	82.3	76.8	73.3	1900	82.5	75.8	76.0	68.2	67.0
1893	85.6	82.7	80.4	73.4	70.7	1901	81.5	81.1	77.2	71.4	61.4

The world's consumption of cotton, 1890–1891 to 1900–1901.

[In bales of 500 pounds.]

Year ended Sept. 30—	Great Britain.	Continent of Europe.	United States.	India.	All other countries.	Total.
1891	3,384,000	3,631,000	2,367,000	924,000	150,000	10,456,000
1892	3,181,000	3,610,000	2,576,000	914,000	160,000	10,471,000
1893	2,866,000	3,692,000	2,551,000	918,000	220,000	10,247,000
1894	3,233,000	3,848,000	2,264,000	959,000	250,000	10,554,000
1895	3,250,000	4,030,000	2,743,000	1,074,000	300,000	11,397,000
1896	3,276,000	4,160,000	2,572,000	1,105,000	419,000	11,532,000
1897	3,224,000	4,368,000	2,738,000	1,004,000	546,000	11,880,000
1898	3,432,000	4,628,000	3,040,000	1,058,000	726,000	12,889,000
1899	3,519,000	4,836,000	3,553,000	1,297,000	845,000	14,050,000
1900	3,334,000	4,576,000	3,856,000	1,140,000	867,000	13,773,000
1901	3,269,000	4,576,000	3,727,000	1,255,000	778,000	13,605,000

Average value per acre of cotton in the United States, 1892–1901, by States.

States and Territories.	1892–93.	1893–94.	1894–95.	1895–96.	1896–97.	1897–98.	1898–99.	1899–1900.	1900–1901.
Virginia	....	....	$5.94	$7.31	$8.07	$7.39	$7.31	$8.32	[See note, page 740.]
North Carolina	....	$12.20	10.00	15.52	14.45	14.66	12.93	14.87	
South Carolina	....	12.24	10.44	17.26	15.97	13.85	11.06	13.28	
Georgia	....	11.97	9.10	14.25	12.71	10.82	10.22	14.61	
Florida	....	12.17	6.67	8.28	7.92	8.67	9.84	14.66	
Alabama	....	12.24	8.97	11.47	10.65	11.81	10.31	12.44	
Mississippi	....	12.92	11.07	16.69	14.47	15.89	11.60	15.87	
Louisiana	....	17.50	15.41	18.42	15.40	18.37	15.11	21.77	
Texas	....	16.59	12.58	13.40	11.00	12.05	13.82	13.88	
Arkansas	....	12.36	11.17	17.98	12.71	16.85	13.40	14.08	
Tennessee	....	11.13	7.61	9.92	8.62	7.98	9.77	9.46	
Missouri	....	....	....	10.13	9.96	9.33	11.00	15.17	
Oklahoma	....	....	....	22.14	15.92	15.55	14.40	12.05	
Indian Territory	....	....	....	13.22	21.16	19.94	18.96	15.16	
General average	....	13.41	10.94	14.53	12.54	13.14	12.23	14.31	

Average plantation price of cotton per pound December 1, 1892–1901, by States.

States and Territories.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Virginia	8.6	7.1	5.0	7.8	7.1	6.9	5.9	7.0	9.2	[See note, page 740.]
North Carolina	8.6	7.2	4.8	8.2	6.7	7.0	5.9	7.2	9.4	
South Carolina	8.6	7.1	5.0	8.8	6.8	6.9	5.6	7.0	9.5	
Georgia	8.5	7.3	4.5	7.0	7.0	6.7	5.6	7.2	9.5	
Florida	8.2	7.3	4.8	11.5	8.7	6.8	5.6	8.4	9.0	
Alabama	8.5	7.0	4.8	7.8	6.5	6.7	5.7	7.0	9.3	
Mississippi	8.5	7.0	4.1	7.5	6.7	6.7	5.7	7.0	9.4	
Louisiana	8.4	7.0	4.3	7.8	6.7	6.7	5.7	6.9	9.2	
Texas	8.0	6.9	4.5	7.3	6.5	6.6	5.8	6.8	8.9	
Arkansas	8.5	6.8	4.8	7.6	6.4	6.5	5.8	6.9	9.0	
Tennessee	8.5	6.5	4.5	7.3	6.2	6.6	5.7	7.5	9.0	
Missouri	7.8	......	4.6	7.4	6.2	6.4	5.8	7.0	7.9	
Oklahoma	......	......	4.6	7.5	6.2	6.7	5.8	6.8	8.7	
Indian Territory	......	......	......	7.3	......	6.4	5.8	6.9	8.7	
General average	8.4	7.0	4.6	7.6	6.6	6.6	5.7	7.0	......	

Acreage, production, value, prices, and exports of cotton of the United States, 1866–1900.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per pound, Dec. 1.	Value.	New York closing prices per pound on middling upland.				Domestic exports fiscal years beginning July 1.
						December.		May of following year.		
						Low.	High.	Low.	High.	
	Acres.	*Bales.*	*Bales.*	*Cents.*	*Dollars.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Bales of 500 pounds.*
1866	6,300,000	.33	2,097,254	......	204,561,896	33 1/2	31 3/4	27 1/2	28 1/2	1,322,947
1867	7,000,000	.36	2,519,554	......	199,583,510	15 1/4	17 1/4	30 1/2	32 3/4	1,569,527
1868	7,000,000	.34	2,366,467	......	226,794,168	24 5/8	25 3/8	28 5/8	28 3/4	1,288,656
1869	7,750,000	.40	3,122,551	16.5	261,067,037	25	25 1/2	22 1/2	23 1/2	1,917,117
1870	8,680,000	.50	4,352,317	12.1	292,703,086	15	15 7/8	14 7/8	17 5/8	2,925,856
1871	7,378,000	.40	2,974,351	17.9	242,672,804	19 1/8	20 1/4	23 3/4	26 3/8	1,867,075
1872	8,500,000	.46	3,930,508	16.5	280,552,629	19 1/8	20 3/4	19 1/4	19 3/8	2,400,125
1873	9,350,000	.45	4,170,388	14.1	289,853,486	15 3/8	16 1/2	17 3/4	18 7/8	2,717,205
1874	10,982,000	.35	3,832,991	13.0	228,113,080	14 1/8	14 7/8	16 1/8	16 3/8	2,520,838
1875	10,803,030	.43	4,632,313	11.1	233,109,915	13 1/16	13 5/16	11 13/16	13 1/8	2,982,811
1876	11,677,250	.38	4,474,069	9.9	211,655,041	12 1/16	12 1/2	10 13/16	11 5/8	2,890,738
1877	12,600,000	.38	4,773,865	10.5	235,721,194	11 1/4	11 1/2	10 5/8	11 1/4	3,215,067
1878	12,266,800	.41	5,074,155	8.2	193,467,706	8 13/16	9 1/2	11 7/8	13 3/4	3,256,716
1879	12,595,500	.46	5,761,252	10.2	242,140,987	12 3/8	13 7/16	11 11/16	11 7/8	3,644,122
1880	15,475,300	.43	6,605,750	9.8	280,266,242	11 7/8	12	10 7/16	10 7/8	4,381,857
1881	16,710,730	.33	5,456,048	10.0	294,135,547	11 7/8	12 1/8	12 1/16	12 3/8	3,479,952
1882	16,791,557	.41	6,949,756	9.9	309,696,500	10 1/4	10 7/16	10 1/8	11 1/8	4,576,150
1883	16,777,993	.34	5,713,200	9.0	250,594,750	10 3/8	10 13/16	11 1/8	11 3/4	3,725,145
1884	17,439,612	.33	5,706,165	9.2	253,993,385	10 7/16	11 7/16	10 11/16	11	3,783,319
1885	18,300,865	.36	6,575,691	8.5	269,989,812	9 3/16	9 7/16	9 3/16	9 5/16	4,116,075
1886	18,454,603	.35	6,505,087	8.1	309,381,938	9 3/16	9 11/16	10 1/4	11 7/16	4,338,915
1887	18,641,067	.38	7,046,833	8.5	337,972,453	10 1/8	10 5/8	9 15/16	10 1/16	4,528,212
1888	19,058,591	.36	6,938,290	8.5	354,454,340	9 3/4	9 7/8	11	11 1/16	4,769,033
1889	20,171,896	.36	7,311,322	8.3	402,951,814	10 1/4	10 1/4	11 15/16	12 3/4	4,943,600
1890	20,809,053	.42	8,652,597	8.6	369,568,858	9 3/16	9 7/16	8 7/8	8 15/16	5,811,717
1891	20,714,937	.44	9,035,379	7.3	326,513,298	7 3/4	8 1/16	7 1/4	7 7/16	5,870,140
1892	18,067,924	.37	6,700,365	8.4	262,252,286	9 5/8	10	7 5/8	7 13/16	4,424,230
1893	19,525,000	.39	7,549,817	7.0	274,479,637	7 13/16	8 1/16	7 1/8	7 3/8	5,366,565
1894	23,687,950	.42	9,901,251	4.6	287,120,818	5 11/16	5 13/16	6 3/4	7 5/8	7,034,866
1895	20,184,808	.36	7,161,094	7.6	260,338,096	8 1/4	8 11/16	8	8 5/8	4,670,453
1896	23,273,209	.37	8,532,705	6.6	291,811,564	7 1/16	7 11/16	7 5/8	7 13/16	6,207,510
1897	24,319,584	.45	10,897,857	6.6	319,491,412	5 13/16	5 15/16	6 5/16	6 9/16	7,725,572
1898	24,967,295	.45	11,189,205	5.7	305,467,041	5 5/8	5 7/8	6 1/8	6 1/4	7,575,838
1899	23,403,497	.39	9,142,838	7.0	334,847,868	7 9/16	7 13/16	9 5/16	9 7/8	6,201,166
1900	....	......	10,401,453	......	511,098,111	10	10 5/16	8 1/8	8 1/4	6,661,781

Average yield per acre of cotton in the United States, 1892–1901, by States.

States and Territories.	1891–92	1892–93	1893–94	1894–95	1895–96	1896–97	1897–98	1898–99	1899–1900.	1900–1901.
	Bales.	*Bales.*	*Bales.*	*Bales.*	*Bales.*	*Bales.*	*Bales.*	*Bales.*	*Bales.*	*Bales.*
Virginia	....	....	....	0.21	0.18	0.24	0.25	0.27	0.23	....
North Carolina	....	....	0.31	.35	.38	.42	.50	.48	.41	....
South Carolina	....	....	.34	.38	.42	.46	.50	.44	.38	....
Georgia	....	....	.33	.33	.35	.37	.38	.39	.41	....
Florida	....	....	.33	.24	.20	.18	.21	.23	.28	....
Alabama	....	....	.35	.32	.28	.31	.41	.39	.35	....
Mississippi	....	....	.37	.41	.41	.42	.55	.43	.43	....
Louisiana	....	....	.50	.55	.45	.46	.63	.56	.59	....
Texas	....	....	.48	.45	.33	.31	.39	.48	.37	....
Arkansas	....	....	.36	.48	.44	.39	.58	.49	.39	....
Tennessee	....	....	.34	.33	.24	.26	.28	.36	.26	....
Missouri	....	....	....	.38	.25	.31	.32	.40	.42	....
Oklahoma	....	....	....	.45	.54	.45	.51	.50	.32	....
Indian Territory	....	....	....	.45	.32	.62	.65	.66	.40	....
General average	.436	.371	.387	.418	.355	.367	.448	.448	.391	....

Food constituents of cotton-seed meal.

	Fresh, or air-dry, material.					
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Minimum	5.29	1.72	23.27	1.88	9.13	2.18
Maximum	18.52	10.62	52.88	15.15	38.68	20.66
Average	8.52	7.02	43.26	5.44	22.31	13.45

Prices of middling upland cotton in New Orleans, 1890–1901.

[In cents per pound.]

Year.	January.		February.		March.		April.		May.		June.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1890	9 5/8	10 11/16	10 3/8	10 11/16	10 11/16	11	11	11 11/16	11 9/16	11 7/8	11 7/16	11 7/8
1891	8 15/16	9 5/16	8 3/4	9 1/16	8 3/8	8 3/4	8 5/16	8 11/16	8 5/16	8 3/8	7 7/8	8 1/4
1892	6 13/16	7 3/16	6 1/2	6 7/8	6 1/4	6 5/8	6 3/8	7	7	7 3/16	7 1/16	7 1/4
1893	9 1/4	9 5/8	8 13/16	9 1/4	8 5/16	9	7 7/16	8 3/16	7 1/4	7 5/8	7 5/16	7 7/8
1894	7 5/16	7 3/4	7 1/16	7 7/16	* 7 1/8	7 5/16	7	7 5/16	6 13/16	7 1/16	6 7/8	7 1/8
1895	5	5 3/16	5	5 3/16	5 1/16	5 7/8	5 3/4	6 3/8	6 3/16	7	6 5/8	7
1896	7 13/16	8	7 1/8	8	7 3/8	7 13/16	7 5/8	7 3/4	7 3/8	7 3/4	6 13/16	7 3/8
1897	6 7/8	7	6 11/16	7 3/16	6 15/16	7 3/16	6 15/16	7 9/16	7 5/16	7 9/16	7 3/8	7 5/8
1898	5 3/16	5 3/8	5 1/4	5 11/16	5 7/16	5 3/4	5 9/16	5 3/4	5 11/16	6 1/16	5 7/8	6 1/16
1899	5 3/16	5 1/4	5 3/4	6	5 11/16	6 1/16	5 5/8	5 3/4	5 11/16	5 7/8	5 1/2	5 3/4
1900	7 1/4	7 3/4	7 7/8	9	9	9 7/16	9 1/8	9 1/8	8 13/16	9 1/8	8 13/16	9 13/16
1901	9 5/16	9 11/16	9 1/16	9 5/16	7 15/16	9 1/16	8	8 5/16	7 9/16	8	7 1/4	8 7/16

Year.	July.		August.		September.		October.		November.		December.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1890	11 7/16	11 3/4	10 1/8	11 3/4	9 3/4	10 1/4	9 11/16	10 1/16	9 1/16	9 9/16	8 13/16	9 1/8
1891	7 3/4	7 15/16	7 5/8	8	8	8 1/8	7 15/16	8 3/8	7 3/8	7 7/8	7	7 1/8
1892	7	7 3/16	6 15/16	7 3/16	6 15/16	7 7/16	7 7/16	7 13/16	7 11/16	9 7/8	9 5/16	9 11/16
1893	7 7/16	7 3/4	6 13/16	7 5/8	7 5/16	8 3/16	7 5/8	8 1/8	7 7/16	7 3/4	7 1/8	7 9/16
1894	6 5/8	6 7/8	6 7/16	6 5/8	5 11/16	6 1/2	5 3/16	5 3/4	4 7/8	5 1/8	5 1/16	5 9/16
1895	6 1/2	6 3/4	6 9/16	7 11/16	7 9/16	8 3/4	8 5/16	9 3/16	8 1/16	8 5/8	7 3/4	8 3/16
1896	6 1/8	6 13/16	6 13/16	8	7 5/8	8 1/8	7 1/8	7 5/8	7 3/16	7 1/2	6 11/16	7 3/8
1897	7 11/16	7 13/16	7 1/16	7 11/16	6 1/16	7 1/16	5 1/2	6 1/8	5 1/4	5 1/8	5 1/4	5 3/8
1898	5 5/8	5 7/8	5 3/8	5 11/16	4 7/8	5 5/8	4 13/16	5	4 3/4	5 1/16	5	5 1/4
1899	5 5/8	5 3/4	5 3/4	5 15/16	5 3/4	6 1/8	6 3/4	6 13/16	6 7/8	7 7/16	7 3/16	7 1/2
1900	9 7/8	10 1/4	9 3/8	10 1/4	9 3/8	11 1/8	8 13/16	10 5/16	9	9 7/8	9 1/4	9 13/16
1901	8 1/8	8 7/16	8	8 13/16	7 15/16	8 5/8	7 7/16	8 5/16	7 1/4	7 7/16	7 3/4	8 1/16

Closing prices upland middling cotton per pound, in leading cities of the United States, 1896–1901.

Date.	New York.		New Orleans.		Memphis.		Galveston.		Savannah.		Charleston.		Wilmington.		Norfolk.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1896.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	8 3/16	8 3/8	7 13/16	8	7 3/4	8	7 13/16	8 1/16	7 5/8	7 15/16	7 5/8	7 3/4	7 3/4	7 7/8	7 13/16	8
February	7 13/16	8 1/4	7 1/2	8	7 1/8	7 15/16	7 9/16	8	7 7/16	7 3/4	7 3/8	7 3/4	7 1/2	7 7/8	7 9/16	7 15/16
March	7 5/8	8	7 3/8	7 13/16	7 3/8	7 3/4	7 3/8	7 13/16	7 5/16	7 7/8	7 1/4	7 1/2	7 3/8	7 1/2	7 3/8	7 3/4
April	7 7/8	8 1/8	7 5/8	7 3/4	7 1/2	7 9/16	7 11/16	7 3/4	7 1/2	7 5/8	7 1/2	7 1/2	7 1/2	7 3/4	7 5/8	7 3/4
May	8	8 3/8	7 3/8	7 3/4	7 7/16	7 9/16	7 7/16	7 7/8	7 1/2	7 3/4	7 1/2	7 5/8	7 5/8	7 7/8	7 1/2	7 15/16
June	7 7/16	8	6 13/16	7 1/8	7	7 5/8	6 5/8	7 3/8	7	7 1/2	6 5/8	7 1/2	7 1/8	7 1/2	7 1/8	7 1/4
July	7 1/16	7 7/16	6 1/2	6 13/16	6 5/8	6 7/8	6 3/8	6 9/16	6 5/8	7	6 3/8	6 5/8	7	7 1/8	6 3/4	7 1/8
August	7 7/16	8 5/8	6 13/16	8	6 3/4	7 7/8	6 1/2	8	6 5/8	7 11/16	6 5/8	7 11/16	7 1/4	7 1/2	6 3/4	7 3/4
September	8 3/16	8 7/8	7 1/2	8 1/8	7 3/8	8 1/16	7 1/4	8 1/4	7 1/8	7 15/16	7 1/4	8	7 1/2	8	7 1/2	8 1/4
October	7 15/16	8 3/8	7 1/8	7 5/8	7 1/8	7 5/8	7 1/4	7 3/4	7	7 1/2	7	7 1/8	7 1/4	7 3/4	7 1/4	7 7/8
November	7 5/8	8 3/16	7 3/16	7 1/2	7 1/8	7 7/16	7 1/4	7 9/16	6 7/8	7 3/8	6 7/8	7 1/4	7	7 9/16	7 3/16	7 9/16
December	7 1/16	7 11/16	6 11/16	7 3/8	6 11/16	7 3/16	6 11/16	7 5/16	6 7/16	7	6 1/2	7	6 7/16	7 1/8	6 11/16	7 1/4
1897.																
January	7 1/16	7 5/16	6 7/8	7	6 3/4	6 15/16	6 13/16	7	6 9/16	6 7/8	6 9/16	7	6 5/8	6 7/8	6 3/4	6 15/16
February	7	7 7/16	6 11/16	7 3/16	6 3/4	7	6 3/4	7 1/8	6 5/8	7	6 1/2	7	6 3/4	6 7/8	6 13/16	7 1/16
March	7 3/16	7 7/16	6 15/16	7 3/16	6 7/8	7 1/16	7	7 1/4	6 3/4	7	6 7/8	7	6 7/8	7	7	7 3/16
April	7 5/16	7 3/4	6 15/16	7 9/16	6 15/16	7 3/8	7	7 1/2	6 7/8	7 3/8	6 15/16	7 3/8	7	7 3/8	7 3/16	7 7/16
May	7 5/8	7 13/16	7 3/8	7 9/16	7 1/4	7 3/8	7 1/4	7 1/2	7 3/8	7 1/2	7 1/4	7 3/8	7 3/8	7 1/2	7 1/2	7 5/8
June	7 11/16	7 7/8	7 3/8	7 5/8	7 3/16	7 1/2	7 1/4	7 5/8	7 1/4	7 1/2	7 1/4	7 1/2	7 1/2	7 5/8	7 1/4	7 3/4
July	7 7/8	8	7 5/8	7 13/16	7 1/2	7 13/16	7 5/8	7 11/16	7 1/8	7 3/4	7 1/2	7 3/4	7 5/8	8 1/2	7 3/4	8 1/8
August	7 7/8	8 1/4	7 1/16	7 11/16	7 7/16	7 13/16	7 1/8	7 5/8	7	7 3/4	7	7 3/4	7	8 1/8	8	8 1/8
September	6 1/2	7 13/16	6 1/16	7 1/16	6	7 7/16	6 1/4	7 1/8	5 13/16	7	5 13/16	7	6	7	6 3/16	8
October	6	6 1/2	5 1/2	6 1/8	5 1/8	6 1/16	5 11/16	6 3/8	5 3/8	5 15/16	5 3/8	6	5 1/2	6 1/8	5 9/16	6 1/4
November	5 13/16	6	5 1/4	5 1/8	5 1/4	5 7/8	5 3/8	5 5/8	5 1/8	5 5/16	5 1/8	5 5/16	5 3/16	5 1/2	5 3/8	5 9/16
December	5 13/16	5 15/16	5 1/4	5 3/8	5 1/4	5 5/16	5 3/8	5 1/2	5 1/8	5 3/16	5 3/16	5 3/16	5	5 1/2	5 1/2	5 1/2
1898.																
January	5 [illegible]	5 15/16	5 3/16	5 3/8	5 5/16	5 3/8	5 7/16	5 9/16	5 1/8	5 1/4	5 3/16	5 5/16	5 3/8	5 7/16	5 7/16	5 1/2
February	5 15/16	6 5/16	5 1/4	5 11/16	5 5/16	5 3/4	5 1/2	6	5 3/16	5 15/16	5 1/4	5 3/4	5 3/8	5 3/4	5 1/2	5 15/16
March	6 1/16	6 5/16	5 7/16	5 3/4	5 1/2	5 13/16	5 5/8	6 1/16	5 9/16	5 3/4	5 1/2	5 3/4	5 3/4	6	5 3/4	6
April	6 3/16	6 7/8	5 9/16	5 13/16	5 1/2	6	5 3/4	5 7/8	5 9/16	5 7/8	5 9/16	5 13/16	5 5/8	6 1/4	5 13/16	6 3/16
May	6 5/16	6 3/16	5 11/16	6 1/16	5 3/4	6	5 11/16	6	5 11/16	6	5 3/4	5 3/4	6	6 1/4	6 1/8	6 3/8
June	6 5/16	6 9/16	5 15/16	6 1/16	5 7/8	6	6 13/16	6	5 3/4	6	6	6	5 7/8	6 1/8	6 3/16	6 3/8
July	6 1/16	6 1/4	5 3/8	5 13/16	5 3/4	5 7/8	5 11/16	5 13/16	5 5/8	5 3/4	5 1/2	5 1/2	5 5/8	5 7/8	5 7/8	6 1/8
August	5 3/4	6 1/8	5 5/8	5 11/16	5 3/8	5 3/4	5 7/16	5 11/16	5 1/8	5 11/16	5	5 1/8	5 1/4	5 5/8	5 5/8	5 7/8
September	5 5/16	5 13/16	4 7/8	5 3/8	4 7/8	5 5/16	4 7/8	5 7/16	4 3/4	5 3/16	4 3/4	5 1/8	4 7/8	5 1/4	5 1/8	5 5/8
October	5 5/16	5 1/2	4 3/4	5 1/4	4 5/8	5	4 7/8	6 1/16	4 5/8	4 13/16	4 11/16	4 7/8	4 7/8	5	5	5 1/8
November	5 5/16	5 3/4	4 3/4	5 1/16	4 7/8	5 3/16	4 [illegible]	5 1/4	4 1/2	4 7/8	4 9/16	4 15/16	4 3/4	5	4 15/16	5 1/4
December	5 3/8	5 [illegible]	5	5 1/4	5 1/4	5 3/8	5 1/4	5 1/2	4 [illegible]	5 1/8	4 15/16	5 1/4	5	5 3/8	5 1/4	5 7/16

1899.								
January	5 7/8	6 7/16	5 3/16	5 3/4	5 5/8	5 3/4	5 7/16	6 1/16
February	6 5/16	6 5/8	5 11/16	6	5 11/16	6 1/8	6	6 3/8
March	6 3/16	6 9/16	5 11/16	6 1/8	5 7/8	6 1/8	5 15/16	6 1/4
April	6 1/8	6 5/16	5 5/8	5 7/8	5 3/4	5 7/8	5 7/8	5 15/16
May	6 1/8	6 1/4	5 11/16	5 7/8	5 3/4	5 3/4	5 7/8	5 15/16
June	6 1/16	6 5/16	5 1/2	5 3/4	5 5/8	5 13/16	5 3/4	5 15/16
July	6 1/8	6 1/4	5 5/8	5 3/4	5 5/8	5 3/4	5 7/8	5 7/8
August	6 1/8	6 1/2	5 3/4	5 15/16	5 3/4	5 15/16	5 7/8	6 1/8
September	6 1/4	6 7/8	5 3/4	6 1/8	5 7/8	6 3/4	6 1/16	6 5/8
October	7 1/4	7 3/8	6 1/2	6 15/16	6 3/4	7 1/8	6 15/16	7 1/8
November	7 3/8	7 13/16	6 7/8	7 7/16	7	7 1/2	7 1/16	7 1/2
December	7 1/2	7 3/4	7 3/16	7 1/2	7 1/4	7 7/16	7 1/4	7 7/16
1900.								
January	7 1/4	8	7 1/4	7 3/4	7 3/8	7 11/16	7 1/4	7 11/16
February	8 1/8	9 5/16	7 7/8	8 7/8	7 11/16	8 3/4	7 3/4	8 13/16
March	9 7/16	9 3/8	9	9 7/16	8 7/8	9 7/16	9 1/8	9 5/8
April	9 9/16	9 7/8	9 1/8	9 1/4	9 1/4	9 3/8	9 1/4	9 7/16
May	9	9 5/8	8 13/16	9 1/2	8 3/4	9 7/16	8 7/8	9 7/16
June	8 3/4	9 5/8	8 13/16	10	8 5/8	9 5/8	8 1/2	9 3/8
July	9 13/16	10 1/4	9 5/8	10 1/4	9 3/8	10	9 3/8	9 1/2
August	9 5/8	10 1/4	9 1/2	10 1/4	9 1/2	9 3/4	8 7/8	9 9/16
September	9 3/8	11	9 1/2	11 1/2	9 5/16	11	9 1/4	10
October	9 1/2	11	8 13/16	10 1/4	8 7/8	10 3/16	8 7/8	10
November	9 9/16	10 1/4	9	9 7/8	8 15/16	10	9	9 3/4
December	9 3/4	10 5/16	9 1/4	9 13/16	9 3/8	9 13/16	9 1/4	9 11/16
1901.								
January	9 7/8	12	9 5/16	9 11/16	9	9 5/8	9 3/8	9 11/16
February	9 1/16	10	9 1/16	9 5/16	9 1/16	9 7/16	9 1/8	9 7/16
March	8 1/2	9 15/16	7 13/16	9 1/16	8	9 1/8	8	9 1/8
April	8 1/4	8 9/16	8 1/16	8 5/16	8	8 1/4	8 1/8	8 3/8
May	8 1/16	8 13/16	7 9/16	8	7 9/16	8	7 5/8	8 1/4
June	8 1/4	8 15/16	7 3/4	8 3/8	7 5/8	8 5/16	7 13/16	8 7/16
July	8 1/2	8 3/8	8 1/8	8 7/16	8	8 5/16	8 1/8	8 1/2
August	8	8 3/8	8	8 15/16	8	8 5/8	8 1/16	8 15/16
September	8 3/16	8 3/4	7 15/16	8 3/8	7 13/16	8 5/8	7 15/16	8 15/16
October	7	8 5/16	7 7/16	8 5/16	7 1/2	8 5/8	7 3/8	8 3/8
November	7 13/16	8	7 1/4	7 7/16	7 1/8	7 5/8	7 3/8	7 5/8
December	8	8 3/4	7 5/8	8 7/16	7 5/16	8	7 1/2	8 1/8

1899.								
January	5 1/16	5 3/4	5 1/2	5 3/4	5 3/8	5 7/8	5 3/8	6
February	5 5/8	5 15/16	5 11/16	5 15/16	5 7/8	6	6	6 1/4
March	5 11/16	5 7/8	5 5/8	5 15/16	6	6	6	6 1/8
April	5 5/8	5 11/16	5 1/2	5 5/8	5 7/8	6	5 7/8	6
May	5 5/8	5 5/8	5 1/2	5 9/16	5 7/8	5 7/8	5 7/8	6
June	5 5/8	5 5/8	6 9/16	6 5/8	5 7/8	5 7/8	5 7/8	6 1/8
July	5 5/8	5 5/8	.....	.....	5 7/8	5 7/8	5 7/8	6
August	5 1/2	5 7/8	5 1/2	5 11/16	5 7/8	5 7/8	5 15/16	6 1/8
September	5 5/8	6 1/2	5 1/2	6 5/8	5 7/8	6 1/8	6	6 7/8
October	6 5/8	6 7/8	6 5/8	7	6 1/8	7 1/4	7 1/16	7 3/16
November	6 7/8	7 1/4	6 7/8	7 3/8	7 1/8	7 1/2	7 1/16	7 1/2
December	7 1/8	7 5/16	7 3/16	7 3/8	7	7 1/4	7 5/16	7 1/2
1900.								
January	7 5/16	7 5/8	7 1/4	7 5/8	7 1/4	7 1/2	7 7/16	7 7/8
February	7 11/16	8 15/16	7 5/8	8 3/4	7 1/8	8 3/4	7 7/8	9 1/2
March	9 1/16	9 1/2	9	9 1/8	9	9 1/8	9 1/4	9 7/8
April	9 3/8	9 7/16	9 1/4	9 3/8	9 1/4	9 1/8	9 1/8	9 5/8
May	9	9 7/16	9 5/16	9 3/8	9 1/4	9 1/4	9 1/4	9 5/8
June	8 3/4	9 1/4	.....	.....	.....	.....	8 3/4	9 5/8
July	9 5/16	9 7/8	9 1/2	9 5/8	.....	.....	9 3/4	10 1/16
August	9	9 3/4	8 5/8	9 1/2	.....	.....	9 1/4	10
September	9 1/16	10 3/4	8 7/8	10 3/4	9	10 3/4	9 3/8	11
October	8 13/16	10 1/16	8 3/4	10	9	10 1/4	9	10 5/16
November	8 15/16	9 3/4	9	9 11/16	9	9 5/8	9	9 13/16
December	9 1/16	9 11/16	9	9 5/8	9 1/4	9 5/8	9 1/4	9 3/4
1901.								
January	9 3/8	9 5/8	9 1/4	9 5/8	9 1/4	9 1/2	9 3/8	9 11/16
February	9	9 3/8	9	9 7/8	9	9 1/8	9 1/8	9 7/16
March	7 7/8	9	7 3/4	9	7 7/8	9	8	9 1/4
April	7 15/16	8 1/8	7 7/8	8	7 1/8	7 7/8	8 1/16	8 1/4
May	7 7/16	8 1/16	7 1/2	8	7 3/4	7 7/8	7 5/8	8 1/16
June	7 1/2	8 1/8	7 1/2	8 3/4	7 3/4	7 3/4	7 3/4	8 7/16
July	8	8 1/4	8 1/8	8 1/4	7 3/4	8 1/4	7 3/4	8 1/2
August	7 5/8	8 3/8	7 3/4	8 1/4	8	8 1/4	7 13/16	8 5/8
September	7 5/8	8 3/8	7 5/8	8 5/8	8	8 1/4	8	8 5/8
October	7 3/16	8	7 3/16	8 1/8	7 3/8	8 3/8	7 3/8	8 3/16
November	7 1/8	7 5/16	7 1/8	7 3/8	7 1/8	7 3/8	7 1/4	7 1/2
December	7 1/4	7 15/16	7 11/16	8	7 1/4	7 7/8	7 1/2	8 1/16

TOBACCO.

The production of tobacco in 1899, as shown in the following table, was nearly double that reported by the Eleventh Census, 868,163,275 pounds against 488,256,646. This increase is moie significant in view of the slight gain recorded in 1889 over the figures of 1879, when the total production was 472,661,157 pounds. But this return for 1879 was nearly double that of 1869, when the footing was 262,735,341 pounds, showing the depression due to the civil war. For 1859, the total production was 434,209,461 pounds, and for 1849, 199,752,655.

In 1899 for the first time since the war the production again approached that of 1859, the growth of population being taken into consideration.

Considerably more than one-third of the crop is produced in the State of Kentucky nd more than three-fifths in the three States of Kentucky, Virginia, and North Carolina. Other States which produce tobacco largely are Ohio, 71,422 acres; Maryland, 42,911 acres; Wisconsin, 33,830 acres; Pennsylvania, 27,760 acres; South Carolina, 25,993 acres, and New York, 11,307 acres. The Connecticut and Florida product brings a high price, but the acreage is comparatively insignificant, only 12,175 acres in both States. All the important States show gains in acreage over the figures of 1889, South Carolina going from 394 to 25,993 acres and North Carolina from 97,077 acres to 203,023 acres.

Acreage, production and value of tobacco grown in 1899.

[From Twelfth Census of the United States.]

States and Territories.	Farms reporting tobacco.	Acres.	Pounds.	Value.
The United States	308,317	1,101,483	868,163,275	$56,993,003
North Atlantic division	17,872	53,281	79,272,234	8,233,051
South Atlantic division	117,629	465,751	300,191,090	18,627,038
North Central division	41,047	120,516	123,201,591	8,544,422
South Central division	131,631	461,855	365,413,140	21,577,675
Western division	113	54	31,810	5,716
Alabama	5,287	1,141	311,950	55,581
Alaska	....	....	....	....
Arizona	1	....	100	25
Arkansas	7,781	1,887	831,700	85,395
California	11	27	23,490	4,352
Colorado	....	....	....	....
Connecticut	2,909	10,119	16,930,770	3,074,022
Delaware	1	4	2,000	200
District of Columbia	....	....	....	....
Florida	998	2,056	1,125,600	254,211
Georgia	3,525	2,301	1,105,600	159,659
Hawaii	25	23	50,410	5,101
Idaho	3	1	750	150
Illinois	2,100	2,242	1,447,150	85,411
Indiana	3,990	8,219	6,882,470	445,658
Indian Territory	586	213	97,030	10,284
Iowa	281	131	127,420	8,345
Kansas	207	80	45,960	4,804
Kentucky	86,534	384,805	314,288,050	18,541,982
Louisiana	522	275	102,100	20,488
Maine	2	....	150	14
Maryland	5,338	42,911	24,589,480	1,438,169
Massachusetts	1,009	3,826	6,406,570	956,399
Michigan	102	97	64,580	5,315
Minnesota	186	117	127,730	12,869
Mississippi	1,119	203	62,760	9,225
Missouri	10,475	4,361	3,041,996	218,991
Montana	1	1	200	60
Nebraska	101	14	5,765	610
Nevada	....	....	....	....
New Hampshire	37	109	181,644	27,920
New Jersey	4	2	720	83
New Mexico	7	6	1,460	173
New York	4,221	11,307	13,958,370	1,172,236
North Carolina	51,106	203,023	127,503,400	8,038,691
North Dakota	3	1	210	22
Ohio	16,666	71,422	65,957,100	4,864,191
Oklahoma	96	39	11,880	1,531
Oregon	67	14	4,630	769
Pennsylvania	9,621	27,760	41,502,620	2,959,304
Rhode Island	....	....	....	....
South Carolina	6,744	25,993	19,895,970	1,297,293
South Dakota	11	2	780	85

Acreage, production, and value of tobacco grown in 1899—Continued.

States and Territories.	Farms reporting tobacco.	Acres.	Pounds.	Value.
Tennessee	27,960	71,849	49,157,550	$2,748,495
Texas	1,746	1,443	550,120	104,694
Utah	....	....	....	....
Vermont	69	158	291,390	43,073
Virginia	44,872	184,334	122,884,900	7,210,195
Washington	23	5	1,180	187
West Virginia	5,045	5,129	3,087,140	228,620
Wisconsin	6,919	33,830	45,500,480	2,898,091
Wyoming	....	....	....	....

HOPS.

Hop crop of the countries named, 1896–1900.

[In bales of 180 pounds.]

Countries.	1896.	1897.	1898.	1899.	1900.
California	35,000	45,000	44,500	59,000	....
Oregon	56,000	75,000	71,250	82,300	....
Washington	12,000	32,000	36,200	36,000	....
New York	75,000	75,000	65,000	58,000	....
Total United States	178,000	227,000	216,950	235,300	....
Australia[a]	5,476	7,162	6,560	7,597	....
Austria	121,876	77,896	76,774	132,753	....
Hungary	....	....	3,369	3,383	....
Belgium	....	83,020	30,630	[b]70,311	....
England	281,983	255,787	222,018	411,521	....
France	38,647	44,101	37,411	48,427	....
Germany	310,178	292,247	267,825	336,111	....
Russia	....	64,000	61,240	41,057	....
Total	936,160	1,051,213	922,777	1,286,460	....

[a] Victoria and Tasmania only. [b] Includes Holland.

Wholesale prices of hops per pound in leading cities of the United States, 1897–1901.

Date.	New York.		Cincinnati.		Chicago.	
	Choice State.		Choice.		Pacific coast, common to choice.	
	Low.	High.	Low.	High.	Low.	High.
1897.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	13	13½	13	13½	11	14
February	12	13	13	13½	11	14
March	10½	12	11	12½	10	13
April	9½	10	10	10½	9	12
May	8	9½	9	10	7	12
June	8	8	9	9	8	11
July	7	8	9	9	8	11
August	7	7	8	9	6	10
September	7	15	8	16	8	11
October	14	15	16	16	15	17
November	15	17	16	18	10	17
December	16	18	18	18	12	17
1898.						
January	18	19	16	16	10	17
February	18	19	16	16	10	17
March	17	18	16	16	10	17
April	15	17	15	15	10	16
May	12	15	16	16	10	14
June	12	13	15	15½	10	18
July	11	12	14	15	8	10
August	11	12	14	14	5	10

Wholesale prices of hops per pound in leading cities of the United States, 1897–1901—Continued.

Date.	New York.		Cincinnati.		Chicago.	
	Choice State.		Choice.		Pacific coast, common to choice.	
	Low.	High.	Low.	High.	Low.	High.
1898.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
September	11	15	14	14	5	10
October	15	19	14	19	16	18
November	18	20	20	20	15	19½
December	18	20	19	19	16	19
1899.						
January	18	18	19	19	15	18
February	18	18	18	19	12	18
March	17	18	18	19	13	18
April	15	17	18	18½	13	18
May	16	16	16½	18	12	18
June	15	16	16	18	12	18
July	15	16	16	18	12	18
August	14	15	16	17	12	18
September	12	13	16	16	12½	16
October	13	15	13	13	9	16
November	13	14	13½	13½	9	13
December	12½	14	13	13	7	13
1900.						
January	12½	13½	13	13	....	....
February	12½	13½	13	13	....	....
March	12½	13½	12½	12½	....	....
April	12½	13½	12½	12½	....	....
May	12½	14	10	10	....	....
June	13	14	10	10	....	....
July	13	14	10	10	....	....
August	13	15	10	10	....	....
September	13	15	16½	16½	....	....
October	17	21	16½	16½	....	....
November	20	21	17½	17½	....	....
December	18	21	18	18	....	....
1901.						
January	17	20	17⅘	17⅘	17	18
February	....	....	17 7/10	17 7/10	17	18
March	18	20	17⅘	17⅘	18	19
April	18	20	17⅘	17⅘	18	19
May	17½	20	17 9/10	17 9/10	18	19
June	17½	18	17⅘	17⅘	17	18
July	16	18	17 9/10	17 9/10	17	18
August	14	17	17 7/10	17 7/10	15	16
September	13	16	14¼	14¼	14	15
October	14	15½	14	14	12½	14
November	14	15½	13¾	13¾	12½	14
December	14	15½	13⅝	13⅝	13	15

FLAXSEED.

The wholesale price in Chicago ranged from $1.38½ to $1.90 per bushel in the past year, and the high prices of the previous year were well maintained in the leading markets of the United States. The average price for the two years referred to shows a noticeable increase over the ten previous years.

Flaxseed crop of the countries named, 1898–1900.

Countries.	Seed.			Fiber.		
	1898.	1899.	1900.	1898.	1899.	1900.
	Bushels.	*Bushels.*	*Bushels.*	*Pounds.*	*Pounds.*	*Pounds.*
United States[a]	17,217,000	19,979,000	20,000,000	....	....	....
Manitoba	361,000	315,000	169,000	....	....	....
Mexico	73,000	107,000	[a]150,000	....	....	....
Argentina	7,000,000	9,200,000	8,865,000	....	....	....
Total America	24,651,000	29,601,000	29,184,000	....	....	....
Ireland	....	....	....	15,062,000	16,034,000	22,804,000
Sweden	72,500	66,000	[e]71,000	3,644,000	3,354,000	[e]3,638,000
Netherlands	176,000	[c]254,000	[e]254,000	10,208,000	[c]11,169,000	[e]11,169,000
Belgium	407,000	449,000	[e]402,000	35,386,000	47,989,000	[e]37,832,000
France	357,000	345,000	493,000	25,126,000	27,834,000	42,804,000
Italy[b]	....	....	....	41,917,000	41,917,000	41,917,000
Austria	802,000	735,500	895,000	88,833,000	92,067,000	110,954,000
Hungary	250,000	240,500	165,000	14,939,000	12,821,000	13,436,000
Croatia-Slavonia	51,000	26,500	28,500	10,325,000	7,921,000	8,555,000
Total Austria-Hungary	1,103,000	1,002,500	1,088,500	114,097,000	112,809,000	132,945,000
Roumania	461,000	34,500	260,000	....	....	610,000
Bulgaria	34,000	600	[e]23,000	3,321,000	27,000	[e]2,116,000
Servia[d]	11,000	11,000	11,000	1,156,000	1,156,000	1,156,000
Russia	28,537,500	18,022,000	20,670,000	1,530,776,000	876,788,000	1,015,718,000
Total Europe	31,159,000	20,184,600	23,272,500	1,780,693,000	1,139,077,000	1,312,709,000
British India	17,115,000	11,827,000	[a]12,000,000	....	....	....
Algeria	13,500	7,000	10,000	....	....	....

RECAPITULATION.

America	24,651,000	29,601,000	29,184,000	....	....	....
Europe	31,159,000	20,184,600	23,272,500	1,780,693,000	1,139,077,000	1,312,709,000
British India	17,115,000	11,827,000	[a]12,000,000	....	....	....
Algeria	13,500	7,000	10,000	....	....	....
Total	72,938,500	61,619,600	64,466,500	1,780,693,000	1,139,077,000	1,312,709,000

[a] Commercial estimate.
[b] Average, 1892–1895.
[c] Average, 1896–1898.
[d] 1897 figures.
[e] Average, 1897–1899.

Acreage, production, and value of flaxseed in the United States in 1899, by States.

[From the Twelfth Census of the United States.]

States and Territories.	Acreage.	Production.	Value.
United States	2,110,516	19,979,492	$19,624,901
Alabama	1	4	4
Arkansas	40	408	411
California	904	12,610	10,559
Colorado	434	1,820	1,851
Connecticut	3	30	17
Idaho	17,239	134,180	121,682
Illinois	394	4,336	4,705
Indiana	171	1,394	1,412
Indian Territory	2,785	15,060	12,060
Iowa	126,453	1,413,380	1,380,102
Kansas	192,167	1,417,770	1,262,487
Kentucky	3	10	10
Maine	2	16	22
Maryland	3	50	41
Michigan	883	9,309	10,108
Minnesota	566,801	5,895,479	5,898,556
Missouri	100,952	611,888	519,929
Montana	16	220	268
Nebraska	7,652	54,394	53,793
New Mexico	1	3	3
New York	159	1,350	1,485
North Carolina	2	9	9
North Dakota	773,999	7,766,610	7,735,640
Ohio	3,092	29,821	28,935
Oklahoma	759	5,050	4,562
Oregon	2,016	8,740	8,564
Pennsylvania	75	684	741
South Dakota	302,010	2,452,528	2,422,269
Tennessee	....	7	7
Texas	75	640	561
Utah	1	20	40
Virginia	10	50	52
Washington	149	850	767
West Virginia	2	7	7
Wisconsin	11,263	110,765	143,239

Monthly average prices of flaxseed in Chicago.[a]

[Cents per bushel.]

Month.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
January	135	119¼	95¾	112¾	137¾	140¾	91¼	75⅝	124	115¼	152	166⅛
February	140¾	122¼	95⅝	120	138⅛	141¼	90¾	75¾	126	117	159	168
March	147	120	99	119¼	134⅜	140	88	78¾	120⅝	119⅛	162⅛	157⅛
April	149	120¼	97	114⅛	126	140⅛	90¼	75¾	124	118¼	170⅛	161
May	145⅛	115¼	102⅜	107¾	131⅛	147¾	86	77⅞	131	109¾	178	169⅛
June	140⅛	108⅞	104¼	109	138¾	149¾	79¼	77⅛	113	105¼	177	179
July	132¾	103¼	101¾	107	128¼	133	73	83	96¾	100¾	165	184⅛
August	137¾	104⅛	102¼	94⅝	125¾	107¾	68⅜	103⅞	89	108¼	141	162⅛
September	148⅛	96⅛	106¼	101¾	136	97⅝	70⅞	103¼	89¾	112¾	150⅛	152
October	145	95⅛	109⅜	102	145	94¼	74¼	99¼	98⅛	123¼	166¾	149⅛
November	130	94⅜	109	108¾	146⅛	92⅛	75⅛	106¼	101¾	133⅛	172	146¼
December	118	94¾	109¼	128¼	145⅛	93	75⅜	113¼	108⅜	145	162¼	149¾
Yearly average	139⅛	107⅞	102⅜	110⅛	136	123⅛	80¼	89⅛	110⅛	117⅜	$163\frac{1}{24}$	162⅛

[a] This table exhibits average cash prices for the past twelve years. The monthly prices are the means between the lowest and highest prices for each month, and the yearly prices are the averages of the monthly averages.

Wholesale prices of flaxseed per bushel in leading cities of the United States, 1897–1901.

Date.	St. Louis.		Cincinnati.		Chicago.		Milwaukee.		Duluth.	
	Prime.				No. 1.					
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1897.										
January	$0.73	$0.74	$0.65	$0.70	$0.73	$0.78¼	$0.75	$0.78	$0.71½	$0.75
February	.73	.74	.65	.70	.73¾	.77¼	.75½	.77½	.74½	.77¾
March	.74	.75	.65	.70	.75¾	.81¾	.78	.81½	.75	.79
April	.68	.74	.65	.70	.71½	.80	.75	.80	.72	.78½
May	.74	.75½	.65	.70	.76	.79¾	.76½	.79	.76	.78
June	.74	.75	.65	.70	.75	.80	.76	.80½	.76	.79⅛
July	.74	.80½	.65	.70	.77	.89	.77½	.89	.76½	.88⅛
August	.83	1.11½	.65	.75	.87¾	1.20	.88½	1.20	.88	1.21
September	.93½	1.04½	.70	.85	.96¾	1.09¾	.98	1.09½	.99½	1.09
October	.87½	1.02	.80	.85	.91	1.07½	.91	1.08	.99½	1.07
November	.98½	1.04½	.80	.85	1.02	1.10½	1.06½	1.11	1.00	1.10
December	1.02½	1.13½	.80	.85	1.04	1.22½	1.09	1.22¼	1.05½	1.20
1898.										
January	1.13	1.32	.85	.90	1.16	1.32	1.19½	1.32	1.16½	1.28
February	1.19	1.22	.85	.90	1.21½	1.30½	1.25½	1.30½	1.23	1.27
March	1.12	1.16	.85	.90	1.15¾	1.25½	1.18	1.25¼	1.17	1.22
April	1.12	1.28½	.85	.90	1.16⅛	1.31½	1.18⅛	1.31	1.17½	1.29
May	1.26½	1.36½	.85	.90	1.23	1.39	1.26	1.39	1.21	1.35
June	1.00	1.19	.85	.90	1.04	1.22	1.05½	1.22½	1.01	1.19
July	.84	1.01	.85	.90	.86½	1.07	.90	1.04½	.90	1.06
August	.84	.88	.80	.85	.85	.93	.88	.93	.88½	.93¼
September	.84	.88	.80	.80	.86½	.93	.89	.92¾	.86½	.90⅛
October	.86	.98¾	.80	.80	.89¼	1.07	.90½	1.07	.87¾	1.03⅛
November	.91½	1.01¼	.80	.90	.95	1.08½	.98	1.08	.95	1.03
December	.91¾	1.07	.90	.90	.97¾	1.19	1.03½	1.19	.98	1.12¼
1899.										
January	1.08	1.13½	.90	.90	1.10½	1.20	1.15	1.20	1.11	1.16⅛
February	1.11	1.12½	.90	.90	1.13½	1.20½	1.18	1.20½	1.15	1.18
March	1.10	1.17	.90	1.00	1.14	1.25	1.18	1.24½	1.16	1.21
April	1.10	1.16	1.00	1.00	1.12	1.25	1.17	1.25	1.14¼	1.20
May	.98	1.12½	.90	1.00	1.02	1.17½	1.03¼	1.17½	.99½	1.14
June	.95	1.00	.90	.90	1.00½	1.10	1.03	1.09	.90	1.07
July	.93	.98	.90	.90	.97	1.04½	.99	1.05	.99	1.02
August	.93	1.14½	.90	.90	.96½	1.20	1.00	1.20	1.00	1.00
September	1.02	1.15	.90	.90	1.04½	1.21	1.06	1.20	1.02	1.12½
October	1.12	1.28½	.90	1.00	1.14	1.32½	1.14	1.32½	1.11	1.27
November	1.26	1.30	1.00	1.00	1.27½	1.39¼	1.26½	1.39	1.23	1.38
December	1.34	1.46	1.00	1.00	1.39	1.51	1.39	1.52	1.30	1.42
1900.										
January	1.45	1.50	1.00	1.00	1.48	1.56	1.42	1.56	1.40	1.50
February	1.52	1.58	1.00	1.00	1.58	1.60	1.50	1.60	1.51	1.51¼
March	1.57	1.62	1.00	1.00	1.60	1.65	1.45	1.65	1.56	1.64
April	1.62	1.70	1.00	1.20	1.65	1.75	1.62½	1.73	1.64	1.73
May	1.62	1.65	1.20	1.20	1.76	1.80	1.65	1.80	1.70	1.80
June	1.55	1.58	1.20	1.30	1.74	1.80	1.72½	1.80	1.80	1.80
July	1.35	1.60	1.20	1.30	1.50	1.80	1.42	1.80	1.40	1.80
August	1.25	1.45	1.20	1.20	1.82	1.50	1.30	1.42	1.28½	1.44
September	1.42	1.56½	1.20	1.30	1.41½	1.59½	1.42½	1.75	1.43	1.59
October	1.46	1.75	1.30	1.30	1.47½	1.86	1.48½	1.86	1.48½	1.87
November	1.50	1.78	1.30	1.30	1.60	1.84	1.60	1.82	1.59½	1.85½
December	1.62	1.62	1.30	1.45	1.53½	1.71	1.54	1.68	1.60	1.80½
1901.										
January	1.50	1.72	1.30	1.45	1.56	1.77	....	....	1.57	1.73
February	1.58	1.72	1.30	1.50	1.60	1.76	....	....	1.59	1.72½
March	1.50	1.60	1.35	1.50	1.52	1.63	....	....	1.53½	1.61
April	1.49	1.52	1.20	1.50	1.52	1.70	....	....	1.54½	1.76½
May	1.56	1.67	1.20	1.20	1.64½	1.74	....	....	1.67	1.78
June	1.67	1.68	1.20	1.30	1.70	1.88	....	....	1.50	1.88
July	1.50	1.65	1.30	1.30	1.79	1.90	....	....	1.75	1.88
August	1.37	1.65	1.30	1.40	1.40	1.85	....	....	1.48	1.75
September	1.37	1.38	1.25	1.35	1.38	1.66	....	....	1.37	1.64
October	1.38	1.48	1.25	1.25	1.41	1.58	....	....	1.35	1.55½
November	....	....	1.25	1.30	1.40	1.52½	....	....	1.33	1.50
December	....	....	1.30	1.30	1.38½	1.61	....	....	1.34½	1.56½

SUGAR.

Sugar crop of the countries named, 1897–1898 to 1901–1902.

[In tons of 2,240 pounds.]

Countries.	1897–1898.	1898–1899.	1899–1900.	1900–1901.	1901–1902.
CANE SUGAR.					
United States:					
Louisiana	310,447	245,511	147,164	275,000	275,000
Porto Rico	54,000	53,826	35,000	80,000	100,000
Hawaiian Islands	204,833	252,507	258,521	321,461	310,000
Cuba, crop	314,009	345,260	308,543	635,856	800,000
British West Indies:					
Trinidad, exports	53,000	53,430	41,000	50,000	50,000
Barbadoes, exports	47,835	45,789	50,000	60,000	60,000
Jamaica	30,000	27,000	27,000	30,000	30,000
Antigua and St. Kitts	25,000	22,000	18,000	25,000	25,000
French West Indies:					
Martinique, exports	31,469	31,630	30,000	32,000	32,000
Guadeloupe	37,136	39,390	30,000	35,000	35,000
Danish West Indies:					
St. Croix	13,000	12,000	12,000	13,000	13,000
Haiti and San Domingo	48,000	50,000	45,000	45,000	45,000
Lesser Antilles (not named above)	8,000	8,000	8,000	8,000	8,000
Mexico	....	50,000	78,000	95,000	100,000
Central America:					
Guatemala	9,000	11,000	12,000	9,000	9,000
San Salvador	4,000	4,500	5,000	5,000	5,000
Nicaragua	1,500	3,750	4,000	3,500	3,500
Costa Rica	500	750	1,000	1,500	1,500
South America:					
British Guiana (Demerara), exports	106,000	82,000	80,000	95,000	95,000
Dutch Guiana (Surinam)	6,000	6,000	6,000	6,000	6,000
Venezuela	....	....	2,000	3,000	3,000
Peru, exports	101,577	61,910	100,381	105,000	105,000
Argentine Republic	110,000	72,000	91,507	114,252	115,000
Brazil	200,478	154,495	192,700	190,000	215,000
Total in America	1,715,784	1,632,748	1,582,816	2,237,569	2,441,000
Asia:					
British India, exports	20,000	10,000	10,000	15,000	15,000
Siam	7,000	7,000	7,000	7,000	7,000
Java, crop	531,201	689,281	721,993	709,928	767,130
Philippine Islands, exports	178,000	93,000	62,785	55,400	70,000
Total in Asia	736,201	799,281	801,778	787,328	859,130
Australia and Polynesia:					
Queensland	97,916	164,241	124,070	92,554	113,500
New South Wales	26,000	28,000	15,500	19,000	18,000
Fiji Islands, exports	30,000	34,000	31,000	33,000	30,000
Total Australia and Polynesia	153,916	226,241	170,570	144,554	161,500
Africa:					
Egypt	80,178	87,900	98,500	94,880	95,000
Mauritius	121,693	186,487	157,025	175,267	150,000
Reunion	31,483	37,781	35,000	35,000	35,000
Total in Africa	233,354	312,168	290,525	305,147	280,000
Europe:					
Spain	23,000	25,000	33,215	33,000	33,000
Total cane-sugar production (Willett & Gray)	2,862,255	2,995,438	2,878,904	3,507,598	3,774,630
BEET SUGAR.					
Europe beet-sugar production (Licht):					
Germany	1,852,857	1,721,718	1,798,631	1,979,098	2,295,000
Austria	831,667	1,051,290	1,108,007	1,094,043	1,320,000
France	821,235	830,132	977,850	1,170,322	1,200,000
Russia	738,715	776,066	905,737	920,000	1,060,000
Belgium	265,397	244,017	302,865	340,000	350,000
Holland	125,658	149,763	171,029	178,081	200,000
Other countries	196,245	209,015	253,929	387,450	400,000
Total in Europe	4,831,774	4,982,001	5,518,048	6,068,994	6,825,000

Sugar crop of the countries named, 1897–1898 to 1901–1902—Continued.

Countries.	1897–1898.	1898–1899.	1899–1900.	1900–1901.	1901–1902.
BEET SUGAR—continued.					
United States beet-sugar production (Willett & Gray):					
California	31,381	16,436	37,938	25,451	62,723
Nebraska	6,579	4,721	4,591	4,406	6,660
Utah	1,641	5,764	8,574	7,630	12,748
New Mexico	455	550	466	....	....
New York	342	1,030	1,607	3,669	4,049
Michigan	....	2,253	14,699	23,533	46,692
Minnesota	....	891	2,053	1,186	2,455
Oregon	....	826	982	888	1,250
Illinois	....	....	804	1,150	....
Colorado	....	....	804	5,982	19,977
Washington	....	....	446	625	857
Ohio	....	....	....	1,339	3,126
Wisconsin	....	....	....	....	2,589
Total United States	40,398	32,471	72,944	75,859	163,126
Total cane and beet sugar	7,734,427	8,009,910	8,469,896	9,652,451	10,762,756

Quantity and value of sugar imported into the United States from the principal countries of supply during each fiscal year from 1897 to 1901, inclusive.

[From Section of Foreign Markets.]

QUANTITY.

Countries from which imported.	Annual average, 1897–1901.	Year ended June 30— 1897.	1898.	1899.	1900.	1901.	Per cent in 1901.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Cuba	697,283,907	577,790,173	440,225,111	663,543,657	705,456,230	1,099,404,368	27.66
Dutch East Indies	836,506,253	634,171,629	621,731,462	986,438,330	1,162,202,854	777,986,990	19.57
Germany	750,889,175	1,604,233,071	175,275,440	667,127,773	590,984,996	716,824,596	18.03
Brazil	140,886,750	140,773,692	139,426,285	41,222,162	89,684,600	293,327,013	7.38
British West Indies	250,907,987	322,103,866	231,401,746	267,565,738	200,479,351	232,989,234	5.86
British Guiana	157,196,795	175,639,179	139,145,529	138,152,464	149,715,600	183,331,202	4.61
Austria-Hungary	86,925,913	105,138,128	2,788,767	69,397,343	96,130,457	161,174,865	4.05
Peru	53,235,778	2,863,350	8,544,857	50,080,303	75,155,975	129,534,403	3.26
Santo Domingo	113,445,800	131,279,582	94,336,444	112,213,037	122,206,692	107,193,244	2.70
Belgium	43,423,786	130,423,987	1,366,370	30,000	15,198,903	70,099,670	1.76
Egypt	91,151,146	124,055,211	52,351,144	141,910,690	74,015,702	63,389,981	1.60
Russia, European	9,899,098	815,702	242,575	11,800,295	866,788	32,770,130	.82
Netherlands	30,656,862	82,248,664	38,659,827	6,894,728	153,860	25,327,230	.64
Danish West Indies	19,085,183	16,990,347	14,832,991	22,711,548	21,661,980	19,217,052	.48
United Kingdom	26,538,098	68,250,019	21,106,706	16,685,790	9,375,569	17,272,407	.44
Dutch Guiana	21,826,656	18,043,833	25,636,341	38,124,370	13,265,520	14,063,215	.35
Chinese Empire	8,375,756	11,437,760	7,161,664	10,758,164	4,606,743	7,914,450	.20
British Africa:							
East Africa	27,248,395	25,895,460	12,081,142	55,075,128	36,502,673	6,687,573	.17
Other						....	
Philippine Islands	41,552,466	72,463,577	29,489,600	51,625,280	49,490,542	4,693,333	.12
Nicaragua	878,500	....	482,628	406,252	719,107	2,784,515	.07
Hongkong	3,493,501	3,243,630	4,183,246	5,084,695	2,419,268	2,536,672	.06
Guatemala	2,851,865	....	4,921,135	4,477,566	3,126,580	1,734,044	.04
Canada	1,222,782	1,098,330	717,532	2,020,001	878,778	1,399,269	.04
Mexico	2,162,082	1,412,255	3,059,018	3,088,609	1,892,029	1,358,503	.03
Salvador	701,973	....	....	2,471,012	61,700	992,150	.03
Dutch West Indies	1,896,029	86,652	277,260	5,085,441	3,378,637	652,157	.02
Hawaii	[a] 474,532,679	431,217,116	499,776,895	462,423,600	504,713,105	([b])	......
Porto Rico	[a] 91,206,483	86,607,317	98,452,421	107,208,014	72,558,181	([b])	......
Other countries	43,597,036	150,614,203	22,243,715	33,598,584	11,181,110	347,579	.01
Total	3,916,433,905	4,918,905,733	2,689,920,851	3,980,250,569	4,018,086,530	3,975,005,840	100.00

[a] Annual average, 1897–1900.
[b] From Hawaii 690,880,832 pounds, and from Porto Rico 142,774,452 pounds.

Quantity and value of sugar imported into the United States from the principal countries of supply during each fiscal year from 1897 to 1901, inclusive—Continued.

VALUE.

Countries from which imported.	Annual average, 1897-1901.	Year ended June 30— 1897.	1898.	1899.	1900.	1901.	Per cent in 1901.
Cuba	$16,568,100	$11,982,473	$9,828,607	$16,412,088	$18,243,641	$26,373,690	29.15
Dutch East Indies	17,058,748	13,090,323	11,250,181	19,817,646	24,170,081	16,965,511	18.75
Germany	15,072,755	29,844,019	3,520,796	14,095,417	12,346,734	15,556,811	17.19
Brazil	2,461,270	2,136,989	2,317,990	810,276	1,693,588	5,347,503	5.91
British West Indies	5,231,557	5,893,877	4,552,454	6,049,479	4,603,409	5,058,565	5.59
British Guiana	3,749,491	3,657,025	3,045,666	3,461,889	3,779,398	4,803,479	5.31
Austria-Hungary	1,873,955	1,957,027	67,831	1,485,037	2,132,790	3,727,094	4.12
Santo Domingo	2,614,598	2,059,169	2,030,239	2,659,456	3,365,061	2,959,067	3.27
Peru	1,054,792	56,969	148,599	921,430	1,444,784	2,702,180	2.99
Belgium	884,486	2,311,309	31,909	788	353,699	1,724,724	1.91
Egypt	2,182,721	2,616,423	1,230,071	3,570,343	1,843,077	1,653,695	1.83
Russia, European	242,775	14,927	5,736	340,815	22,993	829,401	.92
Netherlands	754,686	1,916,933	957,908	176,013	4,151	718,422	.79
Danish West Indies	438,294	316,781	312,446	556,562	544,985	460,694	.51
United Kingdom	610,273	1,452,004	504,714	434,237	228,447	431,959	.48
Dutch Guiana	535,568	380,959	585,326	953,047	375,633	382,876	.42
Chinese Empire	228,581	313,803	176,751	296,574	125,986	229,795	.25
Canada	89,751	74,191	32,589	139,023	94,809	108,137	.12
Philippine Islands	715,799	1,199,202	381,279	969,323	925,335	103,857	.11
British Africa:							
East Africa } Other }	408,386	417,850	131,469	835,950	576,585	80,076	.09
Other						....	
Hongkong	95,395	87,465	107,295	141,767	69,697	70,753	.08
Nicaragua	20,749	....	8,195	11,404	18,663	65,483	.07
Guatemala	88,520	....	212,637	118,262	70,416	41,286	.04
Mexico	39,572	19,111	48,682	52,995	41,082	35,994	.04
Salvador	18,636	....	....	63,459	1,521	28,200	.03
Dutch West Indies	51,964	1,761	4,811	136,893	98,014	18,342	.02
Hawaii	[a]16,877,592	13,165,084	16,660,412	17,292,723	20,392,150	([b])	......
Porto Rico	[a]2,109,280	1,577,911	1,913,742	2,495,849	2,449,616	([b])	......
Other countries	767,444	2,522,596	404,414	665,375	234,626	10,206	.01
Total	89,048,365	99,066,181	60,472,749	94,964,120	100,250,974	90,487,800	100.00

[a] Annual average, 1897-1900.
[b] From Hawaii $27,094,095 and from Porto Rico $4,924,694.

RICE.

Wholesale prices of rice per pound, 1897–1901.

Date.	New York. Domestic (good). Low.	New York. Domestic (good). High.	Cincinnati. Louisiana. Low.	Cincinnati. Louisiana. High.	Memphis. Not classed by name. Low.	Memphis. Not classed by name. High.	New Orleans. Low.	New Orleans. High.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
1897.								
January	4⅜	4⅜	3½	6½	4	6	4¼	4½
February	4⅜	4⅜	3½	6½	4	6	4¼	4½
March	4⅜	4½	4	6½	4	7	4¼	4½
April	4½	4⅝	4	6½	4	7	4¼	4½
May	4½	4⅝	4	6½	4	7	4¼	4½
June	4½	4⅜	4	6½	4	7	4¼	4½
July	4½	4⅜	4	6½	4½	6½	4¼	4½
August	4⅝	4¾	4	6½	4	7	4¼	4½
September	4¾	4⅞	4	6½	4	7	4¼	4⅝
October	4⅞	4⅞	4	6½	4	7	4¼	4⅝
November	4⅞	4⅞	4	6½	4	7	4¼	4⅝
December	4⅞	4⅞	4	6¾	4	7	4¼	4½
1898.								
January	4⅞	5	5¾	6¼	4	7	4¼	4½
February	5	5	5¾	6¼	4	7	4½	4¾
March	5	5	5¾	6¼	4	7	4½	4¾
April	5	5⅜	5¾	6½	3¾	7½	4½	5⅜
May	5⅜	5⅜	6¼	7	4¼	8	5¼	5½
June	5⅜	5⅝	6	7	5¼	8	5⅜	5½
July	5⅝	5⅝	6	6½	5¼	8	5⅜	5½
August	5¼	5⅝	5½	6½	4¼	6½	5	5½
September	5	5	5½	6	4¼	6½	4½	5
October	5	5¼	5½	6	4¼	6½	4¾	5
November	5¼	5½	5½	6	4¼	7	4¾	5
December	5¼	5½	5½	6	4¼	7	4¾	5
1899.			Prime.					
January	5½	5½	5¾	6½	4½	7	4¼	5
February	5	5¼	5¾	6½	4½	7	4¼	4¾
March	5¼	5¼	5¾	6¾	4¾	6½	4¼	4¾
April	5¼	5¼	5¾	6¾	3¾	6½	4¼	4¾
May	5¼	5¼	5½	6¾	3¾	6½	4¼	4¾
June	5¼	5¼	5½	6¼	4½	7	4¼	4¾
July	5¼	5¼	5½	6	4½	7	4¼	4¾
August	5	5¼	5½	6	4½	7	4¼	5
September	5	5	5½	6	4½	7	3¾	5⅞
October	5	5⅛	5½	6	3½	7	3¾	6⅛
November	4¾	5	5½	6	3	7	3¾	6⅛
December	4¾	4¾	5½	6	2½	7	3¾	6⅛
1900.			Louisiana.					
January	4¾	4¾	5⅛	6	3	7	3¾	6⅜
February	4¾	4¾	5⅛	6	3	7	3¾	6⅜
March	4¾	4⅞	5⅛	6	3½	7	3¾	6⅜
April	4⅞	4⅞	5⅛	6	3¾	6½	3¾	6¼
May	4⅞	4⅞	5⅛	6	3	7	3¾	6⅛
June	4¾	4¾	5⅛	6	3	7½	4⅛	6⅜
July	4¾	4¾	5⅛	6	3	7½	4½	6⅜
August	4¾	4¾	5⅛	6	3	7½	4½	6⅜
September	4¾	4⅞	5⅛	6	3½	7½	4½	6¼
October	4¾	4⅞	5⅛	6	4	7½	4½	6
November	4¾	5	5⅛	6	4	7	4½	6
December	5	5	5⅛	6	3½	7½	4½	6
1901.								
January	5	5	6½	7½	......	......	......	......
February	4⅞	5	6½	7½	......	......	......	......
March	4⅞	4⅞	6¾	7¼	......	......	......	......
April	4⅞	4⅞	6¾	7¼	......	......	......	......
May	4⅞	4⅞	6¾	7¼	......	......	......	......
June	4⅞	4⅞	6¾	7¼	......	......	......	......
July	4¾	5	6¾	7¼	......	......	......	......
August	5	5	6¾	7¼	......	......	......	......
September	5	5	6¾	7¼	......	......	......	......
October	5	5	6¾	7¼	......	......	......	......
November	4⅞	4⅞	6¾	7¼	......	......	......	......
December	4¾	4¾	6¾	7¼	......	......	......	......

BEANS.

Wholesale prices of beans per bushel in leading cities of the United States, 1897–1901.

Date.	New York.		Cincinnati.		Chicago.		Detroit.		San Francisco.	
	Pea.		Pea.		Pea.		Pea.		Small white, per cwt.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1897.										
January	$0.85	$0.98	$0.85	$0.95	$0.35	$0.80	$0.68	$0.70	....	....
February	.79 5/16	.93	.75	.95	.50	.78	.70	.80	....	....
March	.71	.85¼	.70	.85	.50	.70	.75	.80	....	....
April	.72¼	.86	.70	.80	.50	.72	.65	.80	....	....
May	.80	.90	.70	.90	.50	.77½	.60	.75	....	....
June	.80	.87½	.80	.90	.50	.75	.60	.80	....	....
July	.83½	.88½	.80	.90	.50	.87½	.70	.80	....	....
August	1.16	1.17¼	.80	1.20	.60	1.25	Not quoted.		....	....
September	1.15	1.20	1.10	1.20	.80	1.17½	1.00	1.05	....	....
October	1.11¾	1.14¾	1.05	1.10	.76	1.02½	.90	.95	....	....
November	.95	1.13¼	1.05	1.20	.78	1.00	.85	1.00	....	....
December	1.00	1.16⅝	1.10	1.20	.80	.99	.90	.95	....	....
1898.										
January	1.00	1.06¾	1.10	1.20	.80	1.02	.92	1.00	$1.25	$1.55
February	1.00	1.08	1.10	1.20	.80	1.00	.90	.92	1.65	1.90
March	.99	1.10	1.10	1.20	.88	1.00	.90	.95	1.85	2.10
April	.99½	1.13⅛	1.10	1.35	.85	1.31	.92	1.08	1.90	2.15
May	1.18⅜	1.41	1.30	1.55	1.08	1.30	1.13	1.30	2.00	2.20
June	1.12	1.30	1.20	1.40	.78	1.21	.98	1.05	2.00	2.20
July	1.03	1.24	1.20	1.30	.80	1.15	1.05	1.10	2.00	2.15
August	1.10½	1.27	1.10	1.20	.90	1.15	.97	1.10	2.00	2.15
September	1.05	1.20⅝	1.10	1.20	.90	1.05	1.00	1.00	2.00	2.15
October	1.00	1.24½	1.10	1.20	1.00	1.15	1.00	1.10	2.00	2.15
November	1.00	1.27	1.10	1.20	1.07	1.15	1.00	1.08	2.00	2.15
December	1.05	1.28	1.10	1.20	1.03	1.12	1.05	1.07	2.00	2.15
1899.										
January	1.07	1.27	1.10	1.20	1.03	1.16	1.06	1.13	2.10	2.25
February	1.10	1.26 13/16	1.05	1.20	1.13	1.25	1.06	1.20	2.15	2.25
March	1.10	1.35	1.05	1.45	1.16	1.25	1.15	1.20	2.15	2.25
April	1.10	1.33⅝	1.35	1.45	1.15	1.25	1.14	1.17	2.20	2.30
May	1.10	1.32 7/16	1.35	1.45	.90	1.20	1.01	1.17	2.15	2.20
June	1.10	1.29⅛	1.35	1.45	.90	1.13	1.01	1.06	2.00	2.10
July	1.14⅝	1.38¼	1.15	1.25	.98	1.18	1.04	1.11	2.15	2.20
August	1.24¼	1.36	1.15	1.25	1.00	1.16	1.05	1.11	2.15	2.25
September	1.32⅝	1.40	1.25	1.35	1.00	1.30	1.18	1.32	2.15	2.25
October	1.62	1.68¾	1.30	1.75	1.12	1.65	1.32	1.68	2.15	2.50
November	1.75	1.89	1.65	1.70	1.25	1.85	1.68	1.80	2.90	3.00
December	1.77⅜	2.00	1.65	1.70	1.60	1.87	1.78	1.80	2.90	3.00
1900.										
January	1.86⅜	2.06¼	2.25	2.40	1.70	1.85	1.78	2.05	2.85	3.00
February	1.98	2.13	2.40	2.40	1.90	2.10	1.98	2.05	3.15	3.25
March	1.90	2.11	2.20	2.40	1.90	2.10	2.00	2.00	3.15	3.35
April	1.90	2.15	2.10	2.15	1.95	2.20	2.00	2.08	3.40	3.50
May	1.85⅝	2.25	2.00	2.55	1.90	2.18	2.08	2.10	3.40	3.50
June	1.80	2.25	2.45	2.55	1.90	2.16	2.10	2.10	3.25	3.40
July	1.80	2.21¼	2.45	2.55	1.90	2.15	2.10	2.10	3.40	3.50
August	1.75¼	2.08	2.45	2.55	1.90	2.15	Not quoted.		3.50	3.65
September	1.79	2.07½	2.10	2.55	1.65	2.25	1.55	1.70	3.75	4.00
October	1.95	2.10	2.10	2.25	1.70	1.90	1.70	1.84	3.60	3.75
November	1.91	2.05	2.10	2.25	1.68	1.87	1.70	1.90	3.90	4.00
December	2.14	2.17	2.10	2.25	1.70	2.10	1.90	2.08	4.00	4.50
1901.										
January	2.25	2.35	2.50	2.55	1.75	2.20	1.85	2.15	3.60	4.70
February	2.20	2.27½	2.50	2.50	1.80	2.10	1.94	2.00	3.75	4.90
March	2.00	2.25	2.40	2.50	.90	2.02	1.80	1.88	3.60	4.90
April	2.00	2.12½	2.40	2.40	1.25	1.97	1.80	1.90	3.75	4.95
May	1.97½	2.10	2.40	2.40	1.25	1.90	1.74	1.80	3.70	4.95
June	1.95	2.12½	2.40	2.40	1.50	2.05	1.75	1.95	3.60	4.90
July	2.07½	2.25	2.40	2.40	1.60	2.50	1.85	2.40	3.40	5.00
August	2.30	2.77½	2.40	3.00	2.10	2.80	2.40	2.40	2.00	4.25
September	2.25	2.75	3.00	3.00	1.65	2.75	2.40	2.40	2.05	4.25
October	2.05	2.30	2.60	3.00	1.55	2.00	1.68	1.92	2.00	5.00
November	1.95	2.05	2.60	2.75	1.50	1.92	1.66	1.85	2.50	3.50
December	1.95	2.00	2.60	2.75	1.69	1.85	1.72	1.81	2.80	3.25

CLOVER SEED.

In the past three years prices have advanced materially; the high price in Chicago the last year was $10 per 100 pounds above the low price of 1899. In the year 1899 there was a range of $1.50 to $8.40; in 1900 of $4 to $10.50 and in 1901 of $4 to $11.50. A year ago the highest prices prevailed at the close of the year, there having been a steady advance. The past year the market closed not far from inside figures.

Wholesale prices of clover seed (60 pounds to the bushel), 1897–1901.

Date.	New York. Prime (per 100 pounds). Low.	New York. High.	Cincinnati. Prime (per 100 pounds). Low.	Cincinnati. High.	Chicago. Poor to choice (per 100 lbs.). Low.	Chicago. High.	Toledo. Poor to choice (per bushel). Low.	Toledo. High.	Detroit. Per bushel. Low.	Detroit. High.
1897.										
January	$4.75	$4.75	$3.50	$4.50	$2.00	$8.50	$5.20	$5.32½	$5.20	$5.35
February	4.75	4.75	3.75	4.50	2.00	8.50	4.60	4.90	4.60	5.20
March	4.50	4.50	3.50	4.50	2.00	9.25	4.72½	5.30	4.65	5.25
April	4.50	5.00	3.50	4.50	2.50	8.50	4.30	4.95	4.30	5.10
May	5.00	5.00	3.00	3.50	2.50	7.00	4.25	4.35	4.25	4.35
June	5.00	5.00	....	....	2.00	6.75	4.10	4.10	4.20	4.35
July	5.00	5.00	....	....	2.00	7.00	4.20	4.25	4.20	4.40
August	5.00	5.00	....	....	2.50	7.15	4.30	4.45	4.20	4.40
September	3.75	4.00	3.00	3.60	2.50	7.25	3.30	4.10	3.37½	4.10
October	3.25	3.87½	2.75	3.15	3.00	5.80	3.20	3.40	3.00	3.40
November	3.40	3.60	2.75	3.15	2.50	5.35	3.15	3.37½	3.17½	3.37½
December	3.40	3.55	2.75	3.00	2.50	5.50	3.10	3.20	3.12	3.22½
1898.										
January	3.40	3.55	2.75	3.00	2.50	5.40	3.12½	3.22½	3.12½	3.22½
February	3.45	3.45	2.75	3.00	2.50	5.40	3.05	3.20	3.05	3.20
March	3.45	3.50	2.45	2.90	2.00	5.15	2.85	3.07½	2.80	3.07½
April	3.50	3.50	2.45	2.65	2.50	5.00	2.85	3.15	2.85	3.12½
May	3.37½	3.62½	2.45	2.65	2.50	5.50	3.00	3.30	3.00	3.12½
June	3.50	3.62½	....	....	2.50	5.25	2.80	3.30	2.90	3.25
July	3.50	3.50	....	....	2.50	5.30	2.87½	3.30	2.90	3.30
August	3.50	3.50	....	....	2.00	5.40	3.20	3.32½	3.15	3.30
September	3.50	3.50	3.25	3.50	1.00	8.00	3.25	3.90	3.25	4.00
October	3.45	4.20	3.25	3.75	3.00	8.00	3.75	5.15	3.75	5.20
November	3.97½	4.20	3.25	3.75	1.25	7.75	4.25	4.65	4.55	4.90
December	3.81	3.97½	3.25	3.75	2.50	7.25	4.00	4.65	4.35	4.60
1899.										
January	6.50	6.75	3.00	3.75	3.00	7.00	4.00	4.72½	3.80	4.65
February	6.50	7.00	3.00	3.50	3.00	6.50	3.90	4.07½	3.85	4.15
March	6.25	6.75	2.85	3.40	2.50	6.10	3.42½	3.85	3.40	3.80
April	5.75	6.00	2.85	3.10	2.50	6.25	3.50	3.80	3.45	3.75
May	5.50	5.87½	2.75	3.10	3.00	6.40	3.50	3.85	3.50	4.00
June	5.50	5.50	2.75	3.00	3.00	6.65	3.77½	4.05	3.80	4.00
July	6.00	7.50	2.75	3.25	1.50	6.65	3.85	4.00	3.90	4.00
August	6.00	7.50	3.00	3.50	2.50	6.50	3.75	4.05	3.75	4.00
September	6.50	7.50	3.50	3.75	2.50	8.40	4.60	5.85	4.75	6.25
October	8.50	9.50	3.75	4.50	6.00	8.60	5.50	6.80	5.90	6.50
November	7.75	8.50	3.85	4.50	5.00	8.00	5.40	6.20	5.35	5.75
December	7.75	8.75	3.85	4.50	3.00	8.50	5.40	5.72	5.40	5.70
1900.	Per pound.									
January	.08½	.08¾	4.00	4.50	5.00	8.40	5.57½	5.80	5.60	5.75
February	.08¾	.09	4.00	4.50	5.00	8.50	5.55	5.80	5.50	5.75
March	.09	.10	4.00	4.65	4.00	8.50	5.20	5.67½	5.20	5.50
April	.09½	.09¾	4.00	4.65	5.00	7.75	4.95	5.15	4.80	5.05
May	Nominal.		4.00	4.20	4.00	7.50	5.00	5.00	4.80	4.90
June	Nominal.		4.00	4.50	4.50	8.00	5.10	5.30	4.90	5.35
July	Nominal.		4.25	4.50	4.50	8.00	5.50	5.50	5.10	5.35
August	.10¾	.10¾	4.25	5.20	4.50	8.40	5.40	6.20	5.75	6.55
September	.10¼	.10¾	4.80	5.75	5.00	9.75	6.10	6.10	6.55	6.90
October	.10¼	.10½	5.00	6.00	5.00	10.50	6.50	7.85	6.65	7.10
November	.10	.10½	5.00	5.70	5.00	10.00	6.15	6.40	6.75	6.90
December	.10	.10½	5.00	5.70	4.00	10.50	6.60	6.87½	6.70	6.80
1901.	Per 100 pounds, common to choice.						Prime.			
January	9.00	10.50	5.00	6.25	4.00	11.00	7.10	7.35	6.90	7.80
February	9.25	10.50	5.75	6.60	5.00	11.50	6.80	7.40	6.75	7.85
March	9.00	9.50	6.00	6.40	5.00	11.15	6.55	6.75	6.50	6.80
April	9.50	11.75	5.80	6.40	6.00	11.00	6.50	6.75	6.50	6.65
May	9.50	11.50	5.80	6.00	4.00	10.75	6.30	6.57½	6.00	6.50
June	9.50	10.50	....	....	6.00	9.50	6.40	6.50	6.00	6.00
July	9.50	10.50	....	....	6.00	10.00	6.20	6.60	6.00	6.25
August	9.50	11.25	6.00	6.00	7.00	10.40	5.80	6.60	5.85	6.50
September	....	....	4.50	5.80	4.50	9.85	5.15	5.90	5.15	5.90
October	....	....	4.50	5.10	4.50	8.75	5.15	5.60	5.15	5.60
November	....	....	4.60	5.25	5.00	9.25	5.40	5.65	5.40	5.65
December	....	....	4.75	5.60	6.00	9.50	5.62½	5.90	5.65	5.90

TIMOTHY SEED.

The prices on the new crop of the past year exceeded all former high records for timothy seed. There has been a steady advancement of values for a couple of years, and the difference in Chicago between the low point of two years ago and the high point last year is about $4.25 per 100 pounds. During 1901 there was a range in Chicago prices of $3.35 to $6.55 compared with $2.32½ to $4.65 the year before and $2.25 to $2.55 two years ago.

Wholesale prices of timothy seed (45 pounds to the bushel), 1897–1901.

Date.	New York.		Cincinnati.		Chicago.		Milwaukee.	
	Per bushel.		Per 100 lbs.		Per 100 lbs.		Per 100 lbs.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1897.								
January	$1.28¼	$1.68¾	$1.15	$1.25	$2.60	$2.80	$2.00	$2.70
February	1.28½	1.80	1.15	1.25	2.50	2.80	2.00	2.80
March	1.28¾	1.79	1.15	1.25	2.60	2.75	2.00	2.90
April	1.30⅝	1.82¼	1.15	1.25	2.60	3.10	2.00	3.10
May	1.44	1.89	1.15	1.25	2.70	3.10	2.00	3.10
June	1.44	1.89	....	....	2.70	2.77½	2.00	2.90
July	1.40½	1.77¾	....	....	2.70	2.75	2.00	2.85
August	1.35	1.68¾	1.20	1.25	2.67½	2.95	2.00	3.05
September	1.31⅜	1.64¼	1.15	1.25	2.60	2.90	2.15	3.05
October	1.26	1.58⅛	1.15	1.25	2.57½	2.75	2.15	2.80
November	1.23¾	1.46½	1.15	1.25	2.65	2.67½	2.15	2.80
December	1.23¾	1.46¼	1.15	1.25	2.62½	2.75	2.15	2.80
1898.								
January	1.23¾	1.46¼	1.15	1.25	2.65	2.82½	2.15	2.85
February	1.23¾	1.46¼	1.15	1.25	2.77½	2.95	2.25	3.00
March	1.23¾	1.46¼	1.15	1.25	2.80	3.00	2.35	3.00
April	1.26⅛	1.59 3/16	1.15	1.25	2.65	2.97½	2.35	3.00
May	1.35	1.68¾	1.15	1.25	2.70	2.90	2.20	3.00
June	1.35	1.68¾	....	....	2.60	2.80	2.00	2.90
July	1.30¾	1.63 13/16	....	....	2.55	2.60	2.00	2.60
August	1.30¼	1.57 1/16	1.08	1.17	2.30	2.65	1.75	2.70
September	1.16 9/16	1.53 7/16	.95	1.17	2.32½	2.50	1.50	2.50
October	1.12⅛	1.41⅞	.95	1.10	2.17½	2.37½	1.60	2.50
November	1.12¼	1.35	.95	1.00	2.15	2.30	1.70	2.50
December	1.13⅜	1.35	.95	1.00	2.20	2.30	1.70	2.50
1899.								
January	1.14 5/16	1.26 9/16	.95	1.05	2.30	2.42½	1.70	2.50
February	1.13 15/16	1.35	1.00	1.05	2.40	2.50	1.85	2.50
March	1.19 9/16	1.35	1.00	1.05	2.25	2.40	1.75	2.50
April	1.12⅛	1.30	1.00	1.05	2.25	2.47½	1.75	2.75
May	1.12⅛	1.44⅞	1.00	1.05	2.25	2.40	1.90	2.65
June	1.12⅛	1.46¼	....	....	2.30	2.40	1.90	2.65
July	1.18 13/16	1.38⅜	....	....	2.40	2.50	1.90	2.80
August	1.24 3/16	1.46¼	1.10	1.15	2.40	2.55	1.75	2.80
September	1.23¾	1.52⅝	1.10	1.15	2.35	2.50	1.80	2.60
October	1.23¾	1.57⅛	1.03	1.15	2.35	2.50	1.80	2.45
November	....	....	1.03	1.07	2.37½	2.50	1.90	2.45
December	1.17	1.46¼	1.03	1.07	2.40	2.45	1.85	2.50
1900.	Per 100 pounds.							
January	2.60	3.25	1.03	1.07	2.47½	2.55	2.00	2.50
February	2.50	3.50	1.03	1.12	2.40	2.55	2.00	2.50
March	2.50	3.50	1.05	1.12	2.32½	2.50	1.90	2.55
April	2.75	3.50	1.07	1.12	2.35	2.47½	1.90	2.55
May	2.75	3.50	1.07	1.12	2.40	2.55	1.90	2.60
June	2.75	3.50	1.07	1.12	2.40	3.40	2.00	3.15
July	Nominal.		1.15	1.40	3.00	3.40	2.65	3.25
August	Nominal.		1.35	1.80	3.00	4.02½	2.75	4.25
September	4.20	5.55	1.60	2.00	3.90	4.60	3.50	4.50
October	4.20	5.55	1.70	2.00	4.15	4.40	3.50	4.30
November	4.20	5.50	1.70	1.85	4.20	4.55	3.50	4.02
December	4.50	5.00	1.70	1.85	4.45	4.65	3.50	4.40
1901.								
January	4.50	5.00	1.70	2.00	4.60	4.77½	3.15	4.50
February	4.50	5.00	1.85	2.05	4.35	4.60	4.00	4.40
March	4.00	5.00	1.85	2.00	4.00	4.40	3.75	4.30
April	4.00	5.00	1.80	1.95	3.75	4.15	3.50	4.20
May	4.22	5.55	1.80	1.85	3.35	3.90	3.00	4.00
June	4.22	5.55	....	....	3.60	4.30	3.00	4.60
July	4.25	5.55	....	....	4.30	5.25	3.65	4.75
August	4.25	5.50	2.00	2.40	4.90	5.75	3.75	5.25
September	....	....	2.30	2.45	5.20	5.70	4.25	5.25
October	....	....	2.35	2.60	5.50	5.90	4.25	5.60
November	....	....	2.50	2.65	5.75	6.35	4.50	6.00
December	....	....	2.50	2.90	6.35	6.55	5.00	6.25

Monthly average prices per bushel of timothy seed in Chicago.[a]

Month.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
January	$2.75½	$2.78	$2.79	$4.42½	$4.25	$5.71¼	$3.68¾	$2.70	$2.73¾	$2.36¼	$2.51¼	$4.68¾
February	2.74½	2.82½	2.86	4.46¾	4.17½	5.75	3.75	2.65	2.86¼	2.45	2.47½	4.47½
March	2.73	2.83½	2.88	4.31	4.20	5.56¼	3.35	2.67½	2.90	2.32½	2.41¼	4.20
April	2.82½	2.81	2.91½	4.13	4.27½	5.32½	3.25	2.85	2.81¼	2.36¼	2.41¼	3.95
May	2.92½	2.89	2.91½	3.87½	4.07½	5.25	3.25	2.90	2.80	2.32½	2.47½	3.62½
June	3.08	2.86	2.97	3.75	4.37½	5.37½	3.05	2.73¾	2.70	2.35	2.90	3.95
July	3.03½	2.76½	2.91½	3.97½	4.92½	5.80	3.02½	2.72½	2.57½	2.45	3.20	4.77½
August	3.12	2.80	4.26	3.52½	5.32½	4.80	2.87½	2.81¼	2.47½	2.47½	3.51¼	5.32½
September	2.91	2.71½	3.78	3.35	5.50	3.95	2.56¼	2.75	2.41¼	2.42½	4.25	5.45
October	2.78	2.56½	4.05¼	3.32½	5.43¾	3.50	2.55	2.66¼	2.27½	2.42½	4.27½	5.70
November	2.76	2.68	4.14⅜	3.27⅜	5.52½	3.57½	2.56¼	2.66¼	2.22½	2.43¾	4.37½	6.05
December	2.70	2.72½	4.40	3.85	5.60	3.52½	2.62½	2.68¾	2.25	2.42½	4.55	6.45
Yearly average	2.86⅜	2.77⅓	3.41	3.85⅘	4.80⅓	4.84⅜	3.04½	2.81¾	2.58½	2.40⅛	3.27 1/12	4.88⅔

[a] This table exhibits average cash prices for the past twelve years. The monthly prices are the means between the lowest and highest prices for each month, and the yearly prices are the averages of the monthly averages.

FARM ANIMALS AND THEIR PRODUCTS.

HORSES AND MULES.

In the prices of horses there appears from the figures shown a gradual advance for the past five years. The market for 1901 was steady and a shade higher.

Number and value of horses and mules, 1880–1902.

[See note under Potatoes, page 710.]

Imports and exports of horses and mules, with average prices, 1892–1901.

Year ended June 30—	Imports of horses.			Exports of horses.			Exports of mules.		
	Number.	Value.	Average price.	Number.	Value.	Average price.	Number.	Value.	Average price.
1892	14,074	$2,455,868	$174.50	3,226	$611,188	$189.46	1,965	$238,591	$121.42
1893	15,451	2,388,267	154.57	2,967	718,607	242.20	1,634	210,278	128.69
1894	6,166	1,319,572	214.01	5,246	1,108,995	211.40	2,063	240,961	116.80
1895	13,098	1,055,191	80.56	13,984	2,209,298	157.99	2,515	186,452	74.14
1896	9,991	662,591	66.32	25,126	3,530,703	140.52	5,918	406,161	68.63
1897	6,998	464,808	66.42	39,532	4,769,265	120.64	7,473	545,331	72.97
1898	3,085	414,899	134.49	51,150	6,176,569	120.75	8,098	661,789	82.09
1899	3,042	551,050	181.15	45,778	5,444,342	118.93	6,755	516,908	76.52
1900	3,102	596,592	192.32	64,722	7,612,616	117.62	43,369	3,919,478	90.38
1901	3,785	985,738	260.43	82,250	8,873,845	107.8[illegible]	34,405	3,210,267	93.31

Number, average price, and total value of horses and mules in the United States, January 1, 1902, by States.

[See note under Potatoes, page 710.]

Range of prices for horses in Omaha, monthly, 1897–1901.

Date.	Drafts.		General purpose.		Southern.		Western.		Drivers.		Carriage teams.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1897.												
January	$65.00	$90.00	$30.00	$55.00	$20.00	$40.00	$13.00	$20.00	$40.00	$90.00	$110.00	$225.00
February	75.00	100.00	35.00	60.00	20.00	45.00	15.00	20.00	45.00	100.00	110.00	225.00
March	85.00	110.00	40.00	60.00	20.00	40.00	12.00	20.00	50.00	110.00	125.00	250.00
April	90.00	115.00	40.00	60.00	15.00	35.00	12.00	20.00	60.00	125.00	150.00	300.00
May	85.00	110.00	40.00	60.00	15.00	30.00	14.00	25.00	60.00	125.00	150.00	300.00
June	85.00	110.00	35.00	55.00	15.00	30.00	15.00	25.00	50.00	120.00	150.00	300.00
July	90.00	115.00	30.00	50.00	15.00	30.00	15.00	25.00	45.00	110.00	125.00	250.00
August	100.00	125.00	30.00	50.00	15.00	30.00	15.00	30.00	40.00	100.00	125.00	250.00
September	100.00	125.00	35.00	55.00	10.00	30.00	15.00	30.00	40.00	100.00	150.00	300.00
October	90.00	115.00	35.00	55.00	10.00	30.00	15.00	30.00	35.00	85.00	150.00	300.00
November	85.00	110.00	35.00	60.00	15.00	35.00	15.00	25.00	35.00	85.00	150.00	300.00
December	60.00	85.00	30.00	50.00	20.00	40.00	12.00	20.00	35.00	80.00	100.00	200.00
1898.												
January	75.00	100.00	30.00	55.00	20.00	45.00	13.00	20.00	40.00	90.00	150.00	300.00
February	75.00	100.00	35.00	60.00	20.00	45.00	15.00	20.00	45.00	100.00	150.00	300.00
March	85.00	110.00	40.00	60.00	20.00	40.00	12.00	20.00	50.00	110.00	150.00	300.00
April	90.00	115.00	40.00	60.00	20.00	40.00	12.00	20.00	60.00	125.00	150.00	350.00
May	85.00	110.00	40.00	60.00	20.00	40.00	14.00	25.00	60.00	150.00	150.00	400.00

Range of prices for horses in Omaha, monthly, 1897–1901—Continued.

Date.	Drafts.		General purpose.		Southern.		Western.		Drivers.		Carriage teams.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1898.												
June	$85.00	$110.00	$35.00	$55.00	$15.00	$35.00	$15.00	$30.00	$50.00	$125.00	$150.00	$350.00
July	90.00	115.00	30.00	50.00	15.00	35.00	15.00	35.00	50.00	125.00	125.00	300.00
August	100.00	125.00	30.00	50.00	15.00	35.00	15.00	40.00	40.00	125.00	125.00	300.00
September	100.00	125.00	35.00	55.00	10.00	35.00	15.00	45.00	40.00	125.00	150.00	300.00
October	90.00	125.00	35.00	55.00	10.00	35.00	15.00	45.00	35.00	100.00	150.00	300.00
November	100.00	125.00	35.00	60.00	15.00	35.00	15.00	40.00	35.00	100.00	150.00	300.00
December	70.00	90.00	35.00	50.00	20.00	40.00	12.00	20.00	35.00	100.00	150.00	300.00
1899.												
January	75.00	115.00	35.00	60.00	20.00	45.00	10.00	20.00	95.00	225.00	200.00	300.00
February	80.00	120.00	35.00	65.00	20.00	50.00	10.00	20.00	95.00	225.00	200.00	300.00
March	90.00	125.00	40.00	65.00	20.00	50.00	10.00	20.00	95.00	225.00	200.00	300.00
April	90.00	140.00	40.00	70.00	20.00	50.00	10.00	20.00	95.00	225.00	200.00	300.00
May	100.00	150.00	40.00	70.00	20.00	45.00	12.50	22.50	90.00	325.00	300.00	450.00
June	90.00	140.00	40.00	65.00	15.00	45.00	12.50	25.00	90.00	325.00	300.00	450.00
July	90.00	140.00	40.00	60.00	15.00	45.00	15.00	27.50	75.00	200.00	200.00	325.00
August	90.00	140.00	40.00	60.00	15.00	45.00	17.50	30.00	75.00	220.00	210.00	420.00
September	90.00	140.00	40.00	60.00	15.00	45.00	20.00	40.00	85.00	175.00	215.00	360.00
October	100.00	160.00	40.00	65.00	20.00	45.00	30.00	77.50	90.00	215.00	175.00	435.00
November	90.00	150.00	40.00	60.00	20.00	50.00	30.00	65.00	90.00	325.00	230.00	370.00
December	100.00	160.00	35.00	60.00	20.00	55.00	29.00	45.00	90.00	300.00	200.00	375.00
1900.												
January	75.00	135.00	55.00	85.00	20.00	45.00	10.00	20.00	95.00	225.00	200.00	300.00
February	80.00	150.00	55.00	90.00	20.00	50.00	10.00	20.00	95.00	225.00	200.00	300.00
March	90.00	165.00	55.00	90.00	20.00	50.00	10.00	20.00	95.00	225.00	200.00	300.00
April	90.00	175.00	60.00	100.00	20.00	50.00	10.00	20.00	95.00	225.00	200.00	300.00
May	100.00	150.00	65.00	105.00	20.00	45.00	12.50	22.50	90.00	325.00	300.00	450.00
June	90.00	140.00	40.00	65.00	15.00	45.00	12.50	25.00	90.00	325.00	300.00	450.00
July	90.00	140.00	40.00	60.00	15.00	45.00	15.00	27.50	75.00	200.00	200.00	325.00
August	90.00	140.00	40.00	60.00	15.00	45.00	17.50	30.00	75.00	220.00	210.00	420.00
September	90.00	140.00	40.00	60.00	15.00	45.00	20.00	40.00	85.00	175.00	215.00	360.00
October	100.00	160.00	40.00	65.00	20.00	45.00	30.00	77.50	90.00	215.00	175.00	435.00
November	90.00	150.00	40.00	60.00	20.00	50.00	12.50	45.00	90.00	325.00	230.00	370.00
December	100.00	160.00	35.00	60.00	20.00	55.00	12.50	40.00	90.00	300.00	200.00	375.00
1901.												
January	90.00	150.00	55.00	85.00	25.00	60.00	10.00	30.00	95.00	225.00	200.00	300.00
February	95.00	160.00	55.00	90.00	25.00	60.00	10.00	30.00	95.00	225.00	200.00	300.00
March	90.00	165.00	55.00	90.00	20.00	55.00	10.00	30.00	95.00	225.00	200.00	300.00
April	90.00	200.00	60.00	100.00	20.00	50.00	10.00	35.00	95.00	225.00	200.00	400.00
May	100.00	200.00	65.00	105.00	20.00	45.00	12.50	35.00	90.00	325.00	300.00	450.00
June	90.00	150.00	40.00	80.00	20.00	45.00	12.50	40.00	90.00	325.00	300.00	450.00
July	90.00	160.00	40.00	80.00	15.00	45.00	10.00	45.00	75.00	200.00	200.00	400.00
August	90.00	160.00	40.00	80.00	15.00	45.00	5.00	40.00	75.00	220.00	210.00	420.00
September	90.00	175.00	40.00	80.00	15.00	45.00	5.00	50.00	85.00	175.00	215.00	360.00
October	100.00	175.00	40.00	80.00	20.00	45.00	10.00	60.00	90.00	215.00	175.00	435.00
November	90.00	160.00	40.00	80.00	20.00	50.00	10.00	45.00	90.00	325.00	230.00	370.00
December	100.00	160.00	45.00	85.00	20.00	55.00	12.50	40.00	90.00	300.00	200.00	375.00

CATTLE AND DAIRY PRODUCTS.

Prices of cattle during the five years here given record a good advance over previous years, with the prices in 1901 ranging a shade higher. Prices of butter were steadily maintained. The same may be said of the prices of cheese with the usual decline in the summer.

Numbers and values of milch cows and other cattle, 1880 to 1902.

[See note under Potatoes, page 740.]

Imports and exports of milch cows and other cattle, 1892 to 1901.

Year ended June 30—	Imports.			Exports.		
	Number.	Value.	Average price.	Number.	Value.	Average price.
1892	2,168	$47,466	$21.89	394,607	$35,099,095	$88.95
1893	3,293	45,682	13.87	287,094	26,032,428	90.68
1894	1,592	18,704	11.75	359,278	33,461,922	93.14
1895	149,781	765,853	5.11	331,722	30,603,796	92.26
1896	217,826	1,509,856	6.93	372,461	34,560,672	92.79
1897	328,977	2,589,857	7.87	392,190	36,357,451	92.70
1898	291,589	2,913,223	9.99	439,255	37,827,500	86.12
1899	199,752	2,320,362	11.62	389,490	30,516,833	78.35
1900	181,006	2,257,694	12.47	397,286	30,635,153	77.11
1901	146,022	1,931,433	13.23	459,218	37,566,980	81.81

Number, average price, and total value of cattle in the United States on January 1, 1902, by States.

[See note under Potatoes, page 740.]

Wholesale prices of cattle per 100 pounds, 1897–1901.

Date.	Chicago.		Cincinnati.		St. Louis.		Omaha.	
	Inferior to prime.		Fair to medium.		Good to choice native steers.		Native beeves.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1897.								
January	$1.75	$5.40	$3.35	$3.90	$3.25	$4.50	$3.00	$4.75
February	1.75	5.50	3.25	3.85	3.25	4.50	3.35	4.85
March	2.25	5.65	3.10	3.85	3.25	4.60	3.15	5.00
April	2.40	5.60	3.15	3.90	3.50	5.00	3.50	5.00
May	2.40	5.50	3.35	4.00	4.00	5.00	3.35	4.80
June	2.25	5.45	3.35	4.00	4.00	5.00	3.00	4.90
July	2.25	5.35	3.25	3.90	3.75	5.00	3.35	4.70
August	2.00	5.50	3.00	3.90	3.75	4.90	3.50	5.05
September	2.25	5.75	3.10	3.90	4.00	5.10	3.25	5.20
October	2.25	5.65	3.00	3.90	4.00	5.25	3.00	5.05
November	2.25	5.45	3.15	3.90	4.00	5.25	3.50	4.95
December	2.25	5.60	3.10	3.85	4.00	5.00	3.00	5.00
1898.								
January	2.25	5.60	3.25	4.00	4.25	5.15	3.50	4.75
February	2.40	5.65	3.40	4.00	4.10	5.15	3.50	4.90
March	2.60	5.85	3.40	4.00	4.25	5.30	3.50	5.20
April	2.50	5.75	3.40	4.25	4.10	5.40	3.50	5.00
May	2.70	5.35	3.25	4.15	4.00	5.10	3.50	4.85
June	2.70	5.40	3.10	4.00	4.35	5.15	3.40	5.50
July	2.70	5.55	3.25	4.15	4.35	5.50	3.50	5.40
August	2.70	5.75	3.25	4.25	4.00	5.65	3.75	5.50
September	2.70	5.85	3.25	4.25	4.25	5.65	3.50	5.40
October	2.60	5.90	3.25	4.15	4.50	5.50	3.25	5.35
November	2.50	5.75	3.15	4.10	4.00	5.30	3.25	5.25
December	2.50	6.25	3.25	4.00	4.00	5.40	3.00	5.80
1899.					*1,000 to*	*1,200 lbs.*		
January	2.00	6.30	3.25	4.00	4.25	5.80	3.75	5.50
February	2.50	6.30	3.40	4.00	4.10	5.75	3.75	5.50
March	2.70	5.90	3.40	4.35	4.00	5.00	3.85	5.40
April	2.70	5.90	3.35	4.25	4.10	5.25	4.00	5.50
May	2.70	5.65	3.50	4.50	4.00	5.10	4.25	5.50
June	2.80	5.70	3.50	4.50	4.00	5.40	4.00	5.50
July	2.80	6.00	3.50	4.15	4.10	5.50	4.00	5.80
August	2.80	6.65	3.75	4.35	4.00	5.85	4.00	6.25
September	2.80	6.90	3.25	4.15	4.10	5.90	4.00	6.15
October	2.80	7.01	3.00	4.35	4.00	5.80	4.25	6.30
November	2.80	6.90	3.35	4.25	4.00	5.70	4.50	6.05
December	2.80	7.00	3.40	4.40	4.00	6.00	4.00	7.25
1900.					*1,000 to*	*1,400 lbs.*		
January	2.25	6.60	3.25	4.25	4.20	6.00	4.00	6.25
February	2.25	6.10	3.35	4.35	4.20	5.75	3.75	5.55
March	2.25	6.05	3.40	4.50	4.55	5.50	3.75	5.20
April	2.25	6.00	3.75	4.65	4.50	5.75	3.75	5.25
May	2.50	5.80	4.10	4.70	4.50	5.50	4.00	5.80
June	2.25	5.90	4.00	4.60	4.40	5.60	4.00	5.40
July	2.25	5.75	3.75	4.50	4.25	5.70	4.00	5.50
August	2.25	6.10	3.65	4.60	4.25	6.00	4.00	5.80
September	2.25	6.00	3.75	4.60	4.20	5.85	3.75	5.70
October	1.75	6.00	3.10	4.40	4.10	5.85	3.75	5.50
November	1.75	6.00	3.00	4.15	4.00	5.85	3.75	5.50
December	1.75	....	3.00	4.25	4.10	6.50	3.50	7.50
1901.								
January	2.70	6.15	3.25	4.45	4.75	5.60	3.50	5.35
February	2.70	6.10	3.10	4.30	4.75	5.65	3.50	5.30
March	2.70	6.25	3.15	4.90	4.75	5.60	3.75	5.40
April	2.70	6.10	3.35	4.75	4.75	5.85	3.75	5.45
May	2.70	6.10	3.60	5.05	4.80	6.00	3.75	5.60
June	2.70	6.55	3.75	4.50	5.00	6.00	4.00	5.90
July	2.20	6.55	3.25	4.25	4.75	6.35	4.00	5.75
August	2.20	6.35	2.90	4.50	5.00	6.35	4.00	5.90
September	2.20	6.60	3.10	4.35	5.00	6.40	4.00	6.25
October	2.20	6.85	3.00	4.25	5.50	6.75	4.00	6.40
November	2.10	6.90	3.00	4.15	5.50	7.00	4.00	7.25
December	2.10	7.00	3.15	4.60	5.50	8.25	3.50	6.85

Wholesale prices of butter per pound in leading cities of the United States, 1897–1901.

Date.	New York.		Cincinnati.		Chicago.		Elgin.	
	Creamery extra.		Creamery.		Creamery firsts.		Creamery extra.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1897.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	20	22	15	16	17	21	19	20⅛
February	19	21½	15	17	16	20½	18	21
March	19	20	15	20	16	19	18	22⅛
April	17	22	13	20	14	21	16	20
May	14	17	12	14	12½	16	13⅝	15
June	15	15	12	13	13	15	14	14⅝
July	15	15	12	13	12¼	14¼	14¼	14⅝
August	15	18½	12	18	12¼	18½	14¼	18
September	18	21	15	18	15½	20½	17	22
October	21	23½	16	22	19	23	22	23
November	23	23½	14	18	19	23	22	23
December	22	24	18	20	18	23	21	22½
1898.								
January	20	22	16	20	16	21	19	21
February	20	20½	16	18	16	19½	19	20
March	19	20½	16	18	16	20	18½	19½
April	17	22	14	18	15	21	16½	20
May	15	17	14	16	14	16½	15	16½
June	16	17	13	15	14½	16	15¼	16
July	16½	18½	14	15	14½	17½	16	17½
August	18½	19	16	17	16	18½	18	18½
September	18½	21	16	18	15½	20	18	20
October	20½	23	16	18	17	22	20	22
November	23	23½	18	19	19	22	22	22
December	20	23½	17	18	16	22	20½	22
1899.								
January	19	21	16	18	14	20½	18	20½
February	19	25	17	20	14	21½	20	22
March	20	22	19	20	17	21	20	20½
April	17	21½	18	19	14	21	17	20½
May	16½	19	16	17	14	18½	16	18
June	18	18½	17	18	16	18	18	18
July	17½	18½	16½	18	15½	18	17¼	18
August	17½	21	16½	20	15½	20	18	20
September	20½	23	18	20	17½	22½	21	22½
October	23½	24	18	20	18	23	23½	23½
November	24	27	18	24	19	26	24½	26½
December	26½	28	21	24	21	27	26	27
1900.								
January	24	30	21	27	22	29	24	29
February	24	26	21	22	21	24½	24	24
March	23½	26	21	22	20	24½	24	24½
April	17½	23	16	20	15½	22	18	22½
May	18½	19½	16	18	16	19½	19½	19½
June	....	....	16	18	16½	19½	18	19½
July	19	20	17	18	17	19	19	19
August	18½	21	17	20	17	21	19½	21½
September	21	22	19	21	17½	21½	20½	21½
October	20½	22½	18	21	17	22	20½	22
November	22½	27	20	25	18	25½	22	26
December	25	26	23	24	20	24	24½	25
1901.								
January	21	25	18	21	15	23	21	24½
February	22	24	18	22	16	23	21	23½
March	22	23½	19	21	17	23	21½	23½
April	18	21	17	20	16	20½	20	21½
May	18	18	17	18	15½	18½	18½	18½
June	19	19½	17	19	16	19	18½	19
July	18	19	17	19	16	20	19	20
August	20	21	17	19	16	20½	20	21
September	20	22½	18	20	16	21	20	21
October	21	22½	20	22	17	22	21½	22
November	22½	25½	22	23	18	24½	22	24½
December	24	25½	22	23	20	24½	21½	24½

Wholesale prices of cheese per pound in leading cities of the United States, 1897–1901.

Date.	New York. September, colored.		Cincinnati. Factory.		Chicago. Full cream.		St. Louis. Full cream.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1897.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	10¼	11¾	9	10	3	10	9¾	10¾
February	12	12¼	9	10½	4	11	10¾	11¾
March	12¼	12¼	10	10½	4	11	11¼	11½
April	10½	12¼	10½	11	3	11	11¼	11¾
May	8¼	10⅝	8½	11	3	10½	8¾	11½
June	8	8⅝	7	8	3	8¼	8	8½
July	7⅜	8	7	8	4	8¼	8	8½
August	7¾	9¼	7	9½	4	9¼	8½	10¼
September	9	9¾	8½	9½	4	9¼	9½	10¼
October	8¼	9⅛	8½	9½	4	8½	9½	10
November	8½	8¾	8½	9½	3	8¼	9½	10
December	8½	8½	9	9½	3	8½	9½	10
1898.								
January	8½	8¾	9	9½	3	9	10	10
February	8½	8⅝	9	9½	3	9¼	10	10
March	8	8½	8½	9½	3	9¼	10	10
April	8	9	8½	9	3	9¼	9	10
May	6⅝	8⅝	7	9	5	9¼	9	9½
June	6¾	7¼	7	7½	7¼	7¾	8	8¼
July	7	7¾	7	8	7¾	8¼	8¼	8¼
August	7	7⅝	7½	9	8	8½	8¼	8¾
September	7¼	8½	7½	9	8	8½	8¾	10
October	8¼	8¾	8½	9½	8	9½	10	10
November	8½	9¾	9	9½	9	10½	10	10
December	9¾	10½	10	11	10	11	10	10½
1899.								
January	10½	10½	10½	11½	9½	11	10½	11
February	10½	11	10½	11½	9½	11	11	11
March	11	12¼	11	12¼	9¾	12	11	11½
April	12	12¼	11½	12¼	11	12¼	12¼	12½
May	8½	12	9½	12	9½	11¼	10½	12½
June	7½	8¾	8	10	8	9½	9	9¾
July	8	9½	8½	9½	8¼	9	9¼	10¼
August	9¼	11¼	9	11	8¾	10	10¼	10½
September	11¼	11¾	10¾	12	10	11¾	11¾	12½
October	12	12¾	12	12½	11¼	12¼	13	13
November	12½	12¾	12½	12½	11	12½	12	13
December	12¾	13	12	12½	11	13	12½	12½
1900.					*Twins.*			
January	12¾	13	12	12½	8	12½	12½	12½
February	12¾	13¼	12	12½	8½	12½	12½	12½
March	13¼	13½	12	12½	9	12½	12½	12½
April	11	13½	12	12½	8½	12½	12	12½
May	9¼	11	9	11½	8½	11½	10	11¾
June	9¼	10	8½	9	7	9¾	10	10½
July	9	9½	8½	9½	8	10¼	10½	10¾
August	9¼	10⅝	8½	10½	8	10¾	10¾	12
September	12	12¼	10	10½	9½	11¼	10¼	11¾
October	10⅝	11⅜	10½	11½	10	11½	11¾	12
November	10¾	11	10¾	11	9¼	10¾	11½	11¾
December	11	11½	10¾	11	9¾	10½	11½	11½
1901.								
January	11¼	12	11	12	10½	11½	11½	11½
February	12	12½	11½	12	11½	11½	11	11½
March	12	12½	11½	12	11	11¾	12	12
April	11½	12½	11	12	11½	11¾	11	12
May	8½	9½	8½	12	10½	11¾	10	11
June	9	9¾	8½	9½	9	10½	10	10¾
July	9	9½	8½	9½	9¼	10¼	10	11¼
August	9⅝	9⅞	9	10	10	10¾	11	11½
September	9½	10¼	9½	10	10	10¾	10½	11½
October	10¼	10¾	9½	10½	10	10¾	10½	11½
November	10¼	10¾	10	10½	9¾	10¼	10¾	11¼
December	10	11¼	10	10½	10	10¾	10¾	11¼

SHEEP AND WOOL.

Numbers and values of sheep, 1880–1902.

[See note under Potatoes, page 740.]

Imports and exports of sheep, with average prices, 1892–1901.

Year ended June 30—	Imports.			Exports.		
	Number.	Value.	Average price.	Number.	Value.	Average price.
1892	380,814	$1,440,530	$3.78	46,960	$161,105	$3.43
1893	459,484	1,682,977	3.66	37,260	126,394	3.39
1894	242,568	788,181	3.25	132,370	832,763	6.29
1895	291,461	682,618	2.34	405,748	2,630,686	6.48
1896	322,692	853,530	2.65	491,565	3,076,384	6.26
1897	405,633	1,019,668	2.51	244,120	1,531,645	6.27
1898	392,314	1,106,322	2.82	199,690	1,213,886	6.08
1899	345,911	1,200,081	3.47	143,286	853,555	5.96
1900	381,792	1,365,026	3.58	125,772	733,477	5.83
1901	331,488	1,236,277	3.73	297,925	1,933,000	6.49

Prices of sheep per 100 pounds in leading cities of the United States, 1897–1901.

Date.	Chicago.		Cincinnati.		St. Louis.		Omaha.	
	Inferior to choice.		Good to extra.		Good to choice natives.		Native.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1897.								
January	$2.00	$4.10	$3.00	$4.00	$2.00	$3.75	$2.50	$3.75
February	2.00	4.20	3.35	4.50	2.75	3.75	2.15	4.50
March	2.20	4.50	3.65	4.75	2.75	4.00	2.25	4.25
April	2.80	5.00	4.10	5.00	2.75	4.00	2.50	5.25
May	2.50	5.00	3.65	4.75	2.50	3.75	2.00	4.75
June	2.25	5.00	2.75	4.00	2.50	4.00	1.75	4.25
July	2.35	4.40	2.85	3.75	2.50	3.75	2.25	4.00
August	2.35	4.20	2.75	3.75	2.50	3.50	2.50	4.00
September	2.40	4.25	3.00	4.00	2.50	3.75	3.00	4.00
October	2.40	4.50	2.85	4.00	2.50	4.00	2.50	4.15
November	2.75	5.00	3.25	4.50	2.75	4.00	3.00	4.35
December	3.10	4.90	3.85	4.65	2.75	4.00	2.15	3.75
1898.								
January	3.10	4.80	4.00	4.65	3.00	4.80	3.00	5.25
February	3.50	4.75	4.00	4.65	3.50	4.55	3.00	4.50
March	3.25	4.75	3.75	4.75	3.90	4.35	2.75	4.35
April	3.25	4.85	3.50	4.65	3.20	5.00	3.00	4.70
May	3.00	4.65	3.35	4.00	3.50	4.50	3.50	4.60
June	3.10	5.25	3.25	4.25	4.10	4.85	3.00	5.00
July	3.25	5.25	3.15	4.15	3.50	4.75	3.25	5.00
August	3.00	4.85	3.25	4.25	3.50	4.00	3.50	4.85
September	3.00	4.75	3.10	4.25	3.75	4.35	3.00	4.25
October	3.00	4.70	3.25	4.25	4.00	4.60	3.00	4.50
November	2.50	4.70	3.15	4.10	3.00	4.35	2.75	4.50
December	2.50	4.55	3.25	4.00	3.50	4.25	2.75	4.65
1899.								
January	2.50	4.30	3.10	4.00	3.50	4.25	3.25	4.75
February	2.80	4.55	3.50	4.25	3.50	4.50	3.25	4.50
March	2.90	4.80	3.40	4.25	3.75	4.75	3.25	5.00
April	3.25	5.10	4.00	5.00	4.00	5.15	3.50	5.00
May	3.65	5.65	4.00	5.00	4.25	5.60	3.50	5.50
June	3.25	5.55	3.40	4.35	3.75	5.35	3.00	5.25
July	3.00	5.40	3.00	4.25	4.00	4.75	3.00	4.75
August	2.75	5.15	2.85	4.35	3.50	4.10	3.50	4.50
September	2.75	4.70	3.00	4.00	3.50	4.25	3.25	4.40
October	2.90	4.40	3.00	4.85	3.00	4.20	3.00	4.40
November	2.75	4.50	3.00	3.90	3.10	4.50	3.00	4.60
December	2.75	4.80	3.00	3.90	3.25	5.10	2.75	4.60
1900.								
January	2.60	5.25	3.35	4.75	4.00	5.25	3.25	5.25
February	2.75	5.90	4.00	5.75	4.75	5.50	3.50	5.75
March	3.50	6.10	5.25	6.00	5.25	5.75	3.50	6.10
April	3.50	6.50	5.35	6.00	5.25	6.25	3.50	6.10
May	3.50	6.00	3.00	4.75	4.50	5.50	3.50	6.00
June	2.50	5.50	2.75	4.50	4.25	4.75	3.25	5.25
July	2.50	4.60	2.25	4.25	3.90	4.30	3.00	4.60
August	2.50	4.65	2.00	4.25	3.50	4.25	3.00	4.00
September	2.00	4.25	2.00	3.90	3.40	4.00	2.50	4.00
October	2.50	4.25	1.50	4.00	3.50	4.00	2.00	4.00
November	2.25	4.35	1.25	3.75	3.50	4.00	2.00	4.25
December	2.25	5.00	1.25	3.75	3.65	4.25	2.25	4.85

Prices of sheep per 100 pounds in leading cities of the United States, 1897-1901—Continued.

Date.	Chicago.		Cincinnati.		St. Louis.		Omaha.	
	Inferior to choice.		Good to extra.		Good to choice natives.		Native.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1901.								
January	$2.75	$4.75	$2.75	$4.25	$3.75	$4.50	$3.00	$4.90
February	2.75	4.75	3.25	4.25	4.00	4.50	3.00	4.75
March	2.75	5.00	3.25	4.50	4.00	5.10	3.00	4.85
April	3.00	5.15	3.75	4.50	4.25	5.10	3.00	5.00
May	2.75	5.00	3.50	5.00	4.00	4.75	2.50	4.40
June	2.75	4.65	3.00	4.10	3.25	4.60	2.25	4.25
July	2.65	4.35	3.00	3.75	3.00	3.75	2.25	4.65
August	2.65	4.05	2.25	3.50	3.00	3.75	2.00	3.60
September	2.75	4.00	2.25	3.40	3.00	3.65	2.00	3.60
October	2.75	4.40	2.10	3.25	3.10	3.50	2.25	4.25
November	2.50	4.30	2.10	4.50	3.15	3.75	2.25	3.75
December	2.50	4.50	2.30	4.50	3.25	4.00	2.50	4.50

Wool product of the United States for 1901, by States.

[Estimates of Mr. S. N. D. North.]

States and Territories.	Number of sheep Apr. 1, 1901.	Average weight of fleece, 1901.	Shrinkage, 1901.	Wool, washed and unwashed.	Wool, scoured.
		Pounds.	*Per cent.*	*Pounds.*	*Pounds.*
Maine	251,599	6.00	40	1,509,594	905,756
New Hampshire	65,318	6.50	55	424,567	191,055
Vermont	181,760	6.75	56	1,226,880	539,827
Massachusetts	33,445	6.00	48	200,670	104,348
Rhode Island	6,629	5.50	42	36,460	21,147
Connecticut	23,021	5.50	41	126,616	74,703
New York	973,464	6.00	50	5,840,784	2,920,392
New Jersey	26,363	5.00	47	131,815	69,862
Pennsylvania	775,125	6.00	50	4,650,750	2,325,375
Delaware	6,964	5.00	46	34,820	18,803
Maryland	111,253	5.00	47	556,265	294,820
Virginia	352,000	5.00	42	1,760,000	1,020,800
North Carolina	219,000	4.25	42	930,750	539,835
South Carolina	56,258	4.25	42	239,097	138,676
Georgia	271,534	4.00	40	1,086,136	651,682
Florida	102,654	4.00	42	410,616	238,157
Alabama	228,124	4.00	40	912,496	547,498
Mississippi	255,324	4.50	42	1,148,958	666,396
Louisiana	105,621	4.00	45	422,484	232,366
Texas	2,317,636	6.50	70	15,064,634	4,519,390
Arkansas	168,761	4.25	40	717,234	430,340
Tennessee	294,831	4.25	40	1,253,032	751,819
West Virginia	423,000	5.50	47	2,326,500	1,233,045
Kentucky	464,643	5.00	38	2,323,215	1,440,393
Ohio	2,546,772	5.25	51	13,370,553	6,551,571
Michigan	1,623,991	6.50	52	10,555,942	5,066,852
Indiana	1,020,898	6.50	52	6,635,837	3,185,202
Illinois	631,234	6.50	50	4,103,021	2,051,511
Wisconsin	725,000	6.50	51	4,712,500	2,309,125
Minnesota	409,157	6.55	53	2,679,978	1,259,590
Iowa	727,169	6.50	55	4,726,599	2,126,970
Missouri	656,359	6.00	50	3,938,154	1,969,077
Kansas	186,987	8.00	67	1,495,896	493,646
Nebraska	329,487	7.50	63	2,471,153	914,327
South Dakota	427,260	6.50	60	2,777,190	1,110,876
North Dakota	449,416	6.50	60	2,921,204	1,168,482
Montana	4,526,517	6.75	63	30,553,990	11,304,976
Wyoming	3,580,856	7.50	67	26,856,420	8,862,619
Colorado	1,352,323	6.25	67	8,452,019	2,789,166
New Mexico	3,700,000	4.25	52	15,725,000	7,548,000
Arizona	668,458	7.50	72	5,013,435	1,403,762
Utah	2,804,674	6.00	64	16,828,044	6,058,096
Nevada	612,000	7.25	68	4,437,000	1,419,840
Idaho	2,805,000	7.25	67	20,336,250	6,710,963
Washington	611,000	8.00	73	4,888,000	1,319,760
Oregon	2,021,165	8.00	70	16,169,320	4,850,796
California	1,759,850	7.00	66	12,318,950	4,188,443
Oklahoma	31,000	6.50	63	201,500	74,555
United States	41,920,900	6.33	60.6	265,502,328	104,614,690
Pulled wool	....	....	....	37,000,000	22,200,000
Total product, 1901	....	....	....	302,502,328	126,814,690

Range of prices of wool in Boston, monthly, 1897–1901.

[Cents per pound.]

Date.	Ohio fine unwashed.		Indiana quarter-blood, unwashed.		Ohio XX, washed.		Ohio, No. 1, washed.		Ohio Delaine, washed.		Michigan X, washed.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1897.												
January	13½	14½	16½	17½	19	20	21	22	20	20½	16½	17
February	14	14½	17	17½	20	20½	21	22	20	21	16½	17
March	14½	15	17½	19½	20½	22	22	22	21	23	17	18
April	15	16	19½	20	22	22½	23	24	23	23	18	18½
May	16	16	17¾	20	22	23	23	24	23	23	18	18½
June	16	16½	18	19	22	23	22	23	23	24	18	18½
July	16	17	20	23	24	25	23	26	24	26	19	20
August	17	19	21	23	25	26	26	27	26	27	20	21½
September	19	20	23	24	26	29	27	28	27	30	21½	23
October	20	21	24	24	29	30	28	30	30	30	23	24
November	20	20	23½	24	29	30	30	30	30	30	23	24
December	20	20	23	24	29	30	30	30	30	30	23	24
1898.												
January	20	21	22	24	30	30	30	31	30	32	24	25
February	20	21	22	23	30	30	30	31	31	31	24	24
March	19	20	22	23	29	30	30	30	30	31	23	24
April	19	19	21	22	29	29	29	30	30	30	22½	23
May	19	19	21	22	28	29	29	29	29	30	22½	23
June	19	20	22	23	28	29	29	29	29	29	22	22½
July	19	19	22	23	28	29	29	29	29	29	22½	22½
August	19	20	23	23	29	29	29	30	29	30	22	22½
September	19	19	22½	23	28½	29	29	30	29	30	22	22½
October	19	19	20	22	28	28½	29	29	29	29	22	22
November	19	19	20	21	28	28	29	29	29	29	22	22
December	18	19	20	21	27	28	29	30	28	29	21	22
1899.												
January	18	19	20	21	27	27	29	29	28	29	21	21
February	18	18½	21	21	26½	27	29	29	28	28½	21	21
March	16	17	20	21	25½	26	28½	29	27	28	20	21
April	17	18	21	22	26	26½	29	29	28	28	21	21
May	18	19	22	23	27	27½	29	29	28	29	21	22
June	19	19	22	23	27½	28	29	30	29	31	22	23
July	20	23	23	23	29	32	31	33	32	34	23	25
August	21	23	22	23	31	32	33	34	34	35	24	25
September	22	24	23	24	32	32	34	34	35	35	25	25
October	24	24	24	24	32	33	35	35½	35	36	25	25½
November	24	25	25	26	33	37	35½	37	36	40	26	30
December	25	26	27	28	37	38	37	39	40	40	29	30
1900.												
January	25	26	28	29	37	38	38	39	38	40	29	29
February	25	25	28	29	37	37	38	38	38	38	28	29
March	22	23	27	28	34	36	35	37	35	37½	24	27
April	21	22	26	27	32	34	35	35	35	35	24	24
May	20	21	25	26	31	32	34	35	33	35	24	24
June	19	20	25	25	29	31	32	33	32	33	23	24
July	19	19	24	25	29	29	31	32	31	32	23	23
August	19	19	23	24	28	29	30	31	29	31	22	23
September	18	19	23	24	27½	28	30	30	29	29	22	22
October	18	19	23	24	27	27½	28	29	27½	28	21½	22
November	18	19	23	24	27	28	28	29	28	30	22	23
December	18	18	23	24	28	28	28	28	29	29	22	22½
1901.												
January	17	18	23	23½	27	28	28	29	29	30	22	22
February	16½	17	23	24	27	27	27½	28	28	30	21	22
March	16½	18	22½	23	26	27	26	27	29	30	21	21
April	17	18	22	22½	26½	26½	26	27	28	30	21	21
May	17	17	20	21	26	26	25	26	28	30	20	20
June	17½	18	19½	20	26	26½	25	26	28	29	20	20½
July	18	18	20	20	26½	27	26	26	28	30	21	21½
August	18	18½	20	20	27	27	26½	26½	28	30	20½	21
September	18½	18½	20½	20½	26	27	26	26½	28	28½	21	21
October	18½	18½	20	20	26	26	25	26	28	28	20	21
November	19	19	20	21½	26	27	26	26½	27½	29	21	21
December	19	19½	21½	22	26½	27	26	27	28	29	21	21

Range of prices of wool in Boston, monthly, 1897–1901—Continued.

[Cents per pound.]

Date.	Fine selected Territory, staple scoured.		Fine medium Territory, clothing scoured.		Texas, 12 months, scoured.		Fine free fall, Texas or California scoured.		Pulled, A super, scoured.		Pulled, B super, scoured.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1897.												
January	36	37	30	32	33	35	26	29	31	33	28	30
February	36	37	31	32	34	35	28	29	31	33	28	30
March	37	40	32	36	36	37	29	30	33	35	30	32
April	40	41	35	37	37	39	30	31	35	37	32	34
May	39	40	33	35	38	38	30	30	34	35	31	33
June	39	40	34	36	38	39	30	31	33	35	31	33
July	41	47	37	42	40	45	31	31	36	40	33	36
August	47	50	43	45	45	46	34	35	38	40	35	37
September	51	55	45	47	46	52	35	39	40	46	37	42
October	55	58	48	52	52	55	40	45	46	48	42	43
November	55	57	48	50	52	53	43	45	45	48	41	43
December	54	55	48	48	50	52	42	43	45	48	41	42
1898.												
January	55	57	49	52	52	53	43	45	45	48	41	43
February	54	56	48	50	50	53	42	45	45	47	40	42
March	50	54	45	48	48	50	39	42	45	47	40	41
April	49	50	44	45	46	48	38	39	45	46	38	40
May	47	50	43	45	47	49	38	39	45	47	38	40
June	47	49	43	45	47	48	38	38	43	45	36	38
July	47	49	45	45	48	48	38	39	45	46	38	40
August	47½	49	45	46	48	48	38	39	45	46	38	40
September	47	49	45	46	47	48	38	39	45	46	38	40
October	47	48	44	45	46	47	38	39	45	46	36	38
November	47	48	43	44	44	46	35	38	42	45	34	36
December	46	47	42	43	42	44	35	36	40	42	32	34
1899.												
January	45	46	40	42	42	44	32	33	40	41	32	33
February	41	45	40	40	42	43	32	33	40	42	32	34
March	42	45	38	40	40	42	30	32	40	40	30	31
April	45	45	40	40	41	42	32	33	40	42	31	34
May	45	47	40	42	43	46	33	37	41	44	33	37
June	48	52	43	47	47	50	38	41	42	45	31	37
July	53	58	48	51	51	55	42	45	44	47	36	38
August	55	58	50	52	53	55	43	45	45	47	36	38
September	56	63	51	55	54	56	44	46	46	48	37	40
October	62	63	54	55	56	58	41	46	47	48	40	42
November	63	72	56	62	59	63	46	52	48	52	43	50
December	72	75	60	62	63	65	50	52	53	57	50	52
1900.												
January	73	74	60	62	63	65	52	55	55	57	48	50
February	68	70	58	60	60	62	50	52	55	56	48	49
March	65	67	55	57	58	60	47	50	50	54	46	48
April	63	65	53	55	57	58	47	48	50	52	40	45
May	60	62	51	53	56	57	46	48	47	50	40	42
June	55	60	50	51	53	55	42	46	47	50	40	42
July	53	55	46	50	52	53	41	42	46	47	39	40
August	52	53	46	48	52	52	40	42	45	46	37	40
September	50	52	45	47	50	52	38	40	45	45	36	38
October	50	50	45	45	50	50	38	40	42	45	36	38
November	50	52	45	47	50	50	38	40	43	46	37	40
December	49	50	45	46	48	50	40	40	45	46	37	39
1901.												
January	50	50	39	43	48	48	38	40	42	45	37	38
February	48	50	38	39	47	50	37	40	40	45	35	35
March	43	45	35	38	43	45	36	38	38	42	34	35
April	45	47	38	40	43	47	36	37	38	40	33	34
May	45	47	40	40	45	47	36	37	35	28	31	32
June	45	47	40	42	45	47	36	37	35	39	30	30
July	46	48	42	43	47	50	36	40	37	40	31	33
August	47	50	43	44	48	50	40	40	38	40	33	33
September	49	50	44	44	50	50	40	40	38	40	33	33
October	49	50	42	44	50	50	40	40	38	40	32	32
November	49	50	43	44	48	50	40	42	38	40	32	33
December	49	50	43	44	48	50	40	42	38	40	34	34

Wholesale prices of wool per pound in leading cities of the United States, 1897–1901.

Date.	Boston.		New York.		Philadelphia.		St. Louis.	
	XX Ohio, washed.		XX Ohio.		XX Ohio, washed.		Best tub-washed.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1897.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	19	20	17½	17½	19	20	20½	21½
February	20	20½	17½	17½	19	20	22	22
March	20½	22	17½	17½	19	20	22	23½
April	22	22½	17½	18½	20	22	24	24½
May	22	23	18½	22	21	22	23	24
June	22	23	22	22	21	22	23	23½
July	24	25	22	24	22	23	24	24½
August	25	26	24	25½	23	25	25	28½
September	26	29	25½	28	25	27	28	32
October	29	30	28	30½	28	29	31	32
November	29	30	29	31½	29	31	30	31
December	29	30	29½	30	29	31	30	30
1898.								
January	30	30	30	31	29	30	30	30
February	30	30	30	31	30	31	29	30
March	29	30	30	31	29½	30½	28	29
April	29	29	30	31	28	30	27½	28
May	28	29	29	30	28	29	27	28
June	28	29	29	30	28	29	28	28
July	28	29	29	30	28	29	27½	28
August	29	29	29	30	28½	29½	27½	28
September	28½	29	29	30	29	30	27	27
October	28	28½	29	30	29	30	26	26½
November	28	28	28	29	28	29	25½	26
December	27	28	28	29	28	29	26	26
1899.								
January	27	27	28	29	27	28	26	26
February	26½	27	28	29	26½	27	26	26
March	25½	26	28	29	26½	27	25½	26
April	26	26½	28	29	26	27	26	26
May	27	27½	28	29	25½	26½	26	26½
June	27½	28	28	29	27	28	27	27
July	29	32	28	29	28½	30	26	26½
August	31	32	30	32	29	31	26½	27
September	32	32	30	32	31	32	26½	27½
October	32	33	30	33	32½	33½	28	28½
November	33	37	32	36	33	34	29	32
December	37	38	36	39	35	36	34	35
1900.								
January	37	38	36	39	36	37	29	35
February	37	37	36	39	36	37	35	36
March	34	36	36	39	36	37	33	35
April	32	34	36	37	34	35	33	34
May	31	32	34	37	33	34	33	34
June	29	31	34	36	30	32	28	32½
July	29	29	28	36	29	32	28	29
August	28	29	28	30	29	30	29	29
September	27½	28	28	30	28	30	29	29
October	27	27½	28	30	28	29	29	29
November	27	28	28	30	27	28	29	29½
December	28	28	28	30	27	28	29	29½
1901.								
January	27	28	26½	27	27	28	28	29½
February	27	27	26	26½	27	28	27	28
March	26	27	25½	26	26	27	27	27½
April	26½	26½	25½	26	25	27	27	27
May	26	26	25½	25½	25	27	25	27
June	26	26½	25½	25½	25	27	24	25
July	26½	27	25½	25½	25	26	....	....
August	27	27	25½	25½	26	27	24	24
September	26	27	25½	25½	26	27	24	25
October	26	26	25½	25½	26	27	24	24
November	26	27	25½	25½	26	27	24	25
December	26½	27	25½	25½	26	27	24	24½

HOGS.

Prices ranged generally higher in 1901, and the quotations advanced steadily with slight reactions—the lowest figures ruling in January and the highest in September. The range from the lowest to the highest Chicago prices of the last year was $4.40 per 100 pounds, exceeding the range in any one of the four previous years reported. The yearly Chicago average for 1901 was $5.85⅛, or about 82⅝ cents and $1.87⅝ above 1900 and 1899, respectively, and the highest in twelve years, with the exception of 1893.

Numbers and values of hogs, 1880 to 1902, with exports.

Year.	On farms, January 1.			Exports for year ended June 30.		
	Number.	Value.	Average farm value.	Number.	Value.	Average price.
1880	34,034,100	$145,781,515	$4.28	83,434	$421,089	$5.05
1881	36,247,603	170,535,435	4.70	77,456	572,138	7.39
1882	44,122,200	263,543,195	5.97	36,368	509,651	14.01
1883	43,270,086	291,951,221	6.75	16,129	272,516	16.90
1884	44,200,893	246,301,139	5.57	46,382	627,480	13.53
1885	45,142,657	226,401,683	5.02	55,025	579,183	10.53
1886	46,092,043	196,569,894	4.26	74,187	674,297	9.09
1887	44,612,836	200,043,291	4.48	75,383	564,753	7.49
1888	44,346,525	220,811,082	4.98	23,755	193,017	8.13
1889	50,301,592	291,307,193	5.79	45,128	356,764	7.91
1890	51,602,780	243,418,336	4.72	91,148	909,042	9.97
1891	50,625,106	210,193,923	4.15	95,654	1,146,630	11.99
1892	52,398,019	241,031,415	4.60	31,963	364,081	11.39
1893	46,094,807	295,426,492	6.41	27,375	397,162	14.51
1894	45,206,498	270,384,626	5.98	1,553	14,753	9.50
1895	44,165,716	219,501,267	4.97	7,130	72,424	10.16
1896	42,842,759	186,529,745	4.35	21,049	227,297	10.80
1897	40,600,276	166,272,770	4.10	28,751	295,998	10.30
1898	39,759,993	174,351,409	4.39	14,411	110,487	7.67
1899	38,651,631	170,109,743	4.40	33,031	227,241	6.88
1900	[See note, page 740.]		....	51,180	394,813	7.71
1901			....	22,318	238,465	10.68

Wholesale prices of live hogs per 100 pounds in leading cities of the United States, 1897–1901.

Date.	Cincinnati. Packing, fair to good.		St. Louis. Mixed packers.		Chicago.		Omaha.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1897.								
January	$3.20	$3.55	$3.10	$3.55	$3.00	$3.60	$3.00	$3.50
February	3.35	3.75	3.30	3.65	3.10	3.75	3.10	3.57½
March	3.60	4.10	3.40	4.10	3.35	4.25	3.40	4.05
April	3.90	4.10	3.70	4.15	3.50	4.25	3.70	4.05
May	3.60	3.95	3.40	3.90	3.25	4.05	3.30	3.85
June	3.30	3.55	3.20	3.50	3.05	3.65	3.05	3.45
July	3.40	3.80	3.25	3.87½	3.05	4.00	3.10	3.65
August	3.85	4.40	3.55	4.50	3.45	4.55	3.35	4.15
September	4.15	4.45	3.95	4.47½	3.60	4.65	3.60	4.17½
October	3.55	4.20	3.55	4.30	3.20	4.40	3.30	4.00
November	3.05	3.55	3.30	3.65	3.15	3.80	3.17½	3.62½
December	3.00	3.40	3.35	3.47½	3.10	3.60	2.85	3.45
1898.								
January	3.40	3.90	3.25	3.90	3.35	4.00	3.35	3.80
February	3.65	4.20	3.60	4.10	3.60	4.27½	3.52½	4.00
March	3.75	4.00	3.70	4.10	3.65	4.17½	3.50	3.95
April	3.65	3.95	3.60	4.10	3.60	4.15	3.50	3.90
May	3.90	4.45	3.70	4.55	3.70	4.80	3.75	4.60
June	3.75	4.05	3.35	4.15	3.55	4.50	3.40	4.30
July	3.70	4.00	3.30	4.05	3.60	4.17½	3.40	3.95
August	3.85	4.00	3.50	4.05	3.45	4.20	3.50	3.92½
September	3.80	4.00	3.50	4.05	3.40	4.15	3.40	3.90
October	3.50	3.85	3.40	3.92½	3.25	4.00	3.35	3.80
November	3.35	3.70	3.20	3.80	3.10	3.85	3.10	3.65
December	3.15	3.50	3.10	3.65	3.15	3.75	3.10	4.55
1899.								
January	3.45	3.95	3.40	3.90	3.30	4.05	3.30	3.75
February	3.55	4.05	3.55	4.00	3.45	4.05	3.30	3.77
March	3.60	3.95	3.55	3.97½	3.50	4.00	3.40	3.75½
April	3.70	4.00	3.65	4.12½	3.50	4.15	3.50	3.85
May	3.65	3.92	3.60	3.95	3.45	4.05	3.45	3.80
June	3.65	4.00	3.60	3.90	3.45	4.00	3.25	3.75
July	3.80	4.65	3.75	4.60	3.55	4.70	3.67½	4.42
August	4.35	4.85	4.55	4.85	3.85	5.00	4.10	4.70½
September	4.25	4.80	4.45	4.75	3.90	4.90	4.10	4.52
October	4.15	4.75	4.10	4.65	3.80	4.90	3.95	4.57½
November	3.75	4.20	3.75	4.20	3.55	4.35	3.60	4.12½
December	3.75	4.40	3.80	4.47½	3.50	4.45	3.70	4.20½

Wholesale prices of live hogs per 100 pounds in leading cities of the United States, 1897-1901—Continued.

Date.	Cincinnati. Packing, fair to good.		St. Louis. Mixed packers.		Chicago.		Omaha.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1900.								
January	$4.45	$4.80	$4.40	$4.75	$3.70	$4.92½	$4.15	$4.72½
February	4.85	5.05	4.75	5.05	3.70	5.10	4.40	4.90
March	4.95	5.25	4.85	5.45	4.00	5.52½	4.50	5.17½
April	5.25	5.85	5.45	5.75	4.25	5.85	5.00	5.62½
May	5.15	5.45	5.20	5.50	4.00	5.57½	4.50	5.40
June	5.00	5.30	5.00	5.35	4.10	5.42½	4.57½	5.25
July	5.25	5.55	5.30	5.50	4.25	5.55	4.75	5.25
August	5.25	5.40	5.25	5.50	3.60	5.57½	4.75	5.25
September	5.40	5.60	5.35	5.60	3.50	5.70	4.90	5.35
October	4.45	5.30	4.75	5.40	3.35	5.55	4.25	5.25
November	4.65	5.00	4.70	5.00	3.40	5.10	4.30	4.97½
December	4.60	5.15	4.75	4.95	4.00	5.45	4.55	5.00
1901.								
January	5.15	5.35	4.90	5.30	4.25	5.47½	4.90	5.35
February	5.30	5.75	5.05	5.45	5.10	5.65	5.10	5.42½
March	5.60	6.05	5.25	6.10	4.90	6.20	5.17½	6.00
April	5.65	6.20	5.60	6.15	4.40	6.25	5.50	6.10
May	5.60	5.95	5.50	5.90	4.15	5.97½	5.00	5.82½
June	5.75	6.20	5.70	6.25	4.25	6.30	5.50	6.07½
July	5.70	6.20	5.80	6.20	3.00	6.35	5.25	6.02½
August	5.85	6.80	5.75	6.60	3.00	6.60	5.05	6.45
September	6.75	7.20	6.60	7.10	3.00	7.40	5.85	6.90
October	5.70	6.95	5.90	7.00	4.25	7.10	5.60	6.85
November	5.35	5.70	5.45	6.10	3.75	6.30	4.45	6.15
December	5.80	6.40	6.00	6.50	4.00	6.70	5.40	6.80

Monthly average prices of live hogs in Chicago.[a]

[In dollars per 100 pounds.]

Month.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
January	3.70	3.52½	4.22½	7.45	5.27½	4.25	3.90	3.30	3.67½	3.67½	4.53¾	5.18¾
February	3.92½	3.50	4.57½	7.97½	5.07½	4.12½	3.97½	3.42½	3.93¾	3.75	4.82½	5.37½
March	4.10	4.20	4.55	7.55	4.72½	4.57½	3.90	3.80	3.91¼	3.75	5.07½	5.70
April	4.25	4.80	4.50	7.02½	4.97½	4.91¼	3.60	3.87½	3.87½	3.82½	5.47½	5.90
May	4.03¾	4.62½	4.55	7.40	4.87½	4.58¾	3.27½	3.65	4.25	3.75	5.23¾	5.75
June	3.73¾	4.47½	4.97½	6.62½	4.75	4.65	3.15	3.37½	4.02½	3.72½	5.13¾	5.92½
July	3.75	5.07½	5.65	5.60	5.30	5.10	3.10	3.52½	3.88¾	4.12½	5.20	5.85
August	3.77½	5.10	5.40	5.05	5.35	4.62½	3.10	4.00	3.82½	4.42½	5.16¼	6.05
September	4.32½	4.87½	5.15	6.00	5.82½	4.10	2.97½	4.12½	3.77½	4.40	5.27½	6.60
October	4.05	4.47½	5.36¼	6.37½	5.12½	3.85	3.10	3.80	3.62½	4.35	4.92½	6.27½
November	3.77½	3.82½	5.48¾	5.70	4.32½	3.52½	3.30	3.47½	3.47½	3.95	4.73¾	5.65
December	3.40	3.65	6.12½	5.12½	4.32½	3.47½	3.25	3.35	3.42½	4.00	4.75	6.00
Yearly average	3.90¼	4.34⅜	5.04⅜	6.49	4.99⅜	4.31	3.38¼	3.61½	3.80⅝	3.97⅞	5.02⅝	5.85½

[a] This table exhibits average cash prices of live hogs for the past twelve years. The monthly prices are the means between the lowest and highest prices for each month, and the yearly prices are averages of the monthly averages.

POULTRY AND EGGS.

The figures here presented show how general is the raising of poultry of all kinds throughout the country and how uniformly chickens are distributed. There is considerably more variation between States in growing turkeys, geese, and ducks than in growing chickens.

The returns from poultry raising are also uniform for the different parts of the country. The ratio of the combined production of eggs and poultry for market to the number of fowls reported is more than 50 per cent higher for the Pacific coast and the North Atlantic States than for the other sections. But this difference may be explained for the North Atlantic section by the demand for poultry and eggs by the large cities and by manufacturing communities, which very materially raises prices; and in the Pacific region it is in part due to the higher prices generally prevailing.

As compared with the returns obtained in the census of 1890, there is shown in these figures a decrease of 25,000,000 in the number of chickens and of 9,000,000 of other poultry, but there is an increase of nearly 50 per cent in the number of eggs produced. As compared with the figures of 1880, the number of chickens is more than doubled and the number of eggs produced nearly trebled. The number of poultry other than chickens is nearly 6,000,000 lower than in 1880.

It will be understood, of course, in considering these figures that the collection of statistics in this field is very difficult and the results subject to much uncertainty. For example, the figures for 1899 indicate approximately an egg production of 6 dozen a year for each hen, while those of 1879 and 1889 show a production of only 4 dozen for each hen. Evidently there is no probability that such an increase in productiveness has taken place.

Poultry and eggs, on farms and ranges, by States and Territories, June 1, 1900.

[From the Twelfth Census of the United States.]

States and Territories.	Number of farms reporting.	Poultry and eggs.					
		Number of fowls 3 months old and over, June 1, 1900.				Value of poultry raised in 1899.	Value of all eggs produced in 1899.
		Chickens, including Guinea fowls.	Turkeys.	Geese.	Ducks.		
The United States.	5,096,252	233,598,085	6,599,367	5,676,863	1,807,358	$136,891,877	$144,286,158
Alabama	191,383	4,737,606	129,326	243,657	75,947	2,263,316	1,825,978
Alaska	5	176	....	....	....	179	360
Arizona	3,301	165,200	6,043	840	2,439	114,881	163,274
Arkansas	156,922	5,393,157	140,661	378,475	180,583	2,179,634	2,328,509
California	55,479	3,917,200	158,356	28,419	62,293	2,492,067	3,864,679
Colorado	19,281	968,761	30,781	2,576	15,002	587,536	852,978
Connecticut	23,064	1,073,026	7,717	3,530	14,100	984,207	1,523,319
Delaware	9,312	628,866	19,045	6,438	10,933	596,391	488,401
District of Columbia	95	8,004	46	16	227	5,480	6,492
Florida	31,950	1,107,816	32,869	36,658	6,877	574,703	553,524
Georgia	195,136	4,519,144	103,416	208,997	64,895	2,481,610	1,615,538
Hawaii	967	31,888	4,672	75	21,508	61,546	45,257
Idaho	12,739	516,412	10,211	3,850	9,536	282,468	465,504
Illinois	247,031	16,600,728	446,020	307,657	382,857	11,307,599	8,942,401
Indiana	208,652	11,103,006	345,379	271,004	230,432	8,172,993	7,441,944
Indian Territory	40,575	1,960,505	92,509	77,216	88,069	647,844	625,418
Iowa	211,832	18,907,673	424,306	223,612	487,752	9,491,819	10,016,707
Kansas	155,834	11,966,843	275,330	97,768	216,244	6,491,183	7,237,111
Kentucky	211,891	6,819,079	279,749	541,576	185,064	4,970,063	3,460,607
Louisiana	89,695	3,890,563	115,921	169,936	123,059	1,425,116	1,281,713
Maine	48,013	1,564,853	6,437	4,566	9,708	955,468	2,038,225
Maryland	42,205	2,113,544	101,782	33,389	56,930	2,077,190	1,572,682
Massachusetts	30,501	1,625,269	3,018	6,389	46,017	1,407,681	2,571,341
Michigan	185,211	8,033,581	191,863	78,267	106,399	4,551,945	6,104,462
Minnesota	136,623	7,730,940	193,143	90,975	127,635	2,927,717	4,437,148
Mississippi	187,562	5,194,858	189,698	357,963	95,668	2,387,484	1,871,765
Missouri	265,203	14,903,601	466,665	428,307	278,140	9,525,252	8,815,871
Montana	9,830	531,774	12,637	2,629	9,639	398,487	631,143
Nebraska	108,504	7,417,837	118,892	74,007	201,503	3,400,044	4,068,002
Nevada	1,690	100,661	3,618	880	2,379	71,175	122,522
New Hampshire	23,500	870,461	2,380	1,289	3,808	610,696	1,218,703
New Jersey	30,958	1,993,594	82,378	10,518	40,024	2,265,816	1,938,304
New Mexico	5,558	156,858	3,805	830	1,527	90,152	157,175
New York	206,389	8,964,736	190,879	45,933	150,864	6,161,429	8,630,062
North Carolina	196,721	3,871,858	120,737	284,424	102,942	2,689,970	1,810,116
North Dakota	34,461	1,409,285	39,073	17,206	23,816	594,751	782,790
Ohio	258,821	14,269,525	362,924	179,665	206,238	8,847,009	10,280,769
Oklahoma	51,012	2,527,353	86,450	12,934	71,562	1,302,460	1,284,414
Oregon	29,997	1,290,818	36,081	26,580	19,774	826,687	1,162,071
Pennsylvania	209,897	10,553,106	259,824	60,780	171,271	7,151,243	9,080,725
Rhode Island	4,868	500,618	4,604	6,335	8,957	398,790	656,845
South Carolina	132,401	2,664,784	120,140	88,543	39,852	1,539,755	925,968
South Dakota	44,756	3,028,700	53,740	33,334	62,511	1,020,382	1,727,392
Tennessee	207,562	6,184,210	193,397	391,698	202,432	4,282,740	3,115,835
Texas	301,713	13,562,302	618,671	415,709	234,664	5,311,362	4,672,187
Utah	16,145	531,842	10,649	2,759	8,508	262,508	424,628
Vermont	28,711	806,451	22,089	5,187	8,836	689,109	959,965
Virginia	154,123	4,590,311	207,675	125,495	117,989	3,744,651	2,836,899
Washington	26,340	1,196,639	29,155	61,488	66,433	848,291	1,259,225
West Virginia	85,041	2,759,585	105,265	129,948	58,278	1,843,752	1,877,675
Wisconsin	156,171	8,097,399	155,121	102,221	92,800	3,398,427	4,854,020
Wyoming	3,660	142,135	3,664	1,312	2,452	79,488	163,517

Wholesale prices of eggs per dozen in leading cities of the United States, 1897–1901.

Date.	New York. Average best fresh.		Cincinnati.		Chicago. Fresh.		St. Louis. Average best fresh.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1897.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	15	22	10½	12½	12	20	10	16
February	15	19	12	13½	13	17	11	14
March	10	15½	7½	9	8½	13½	7	11½
April	9¼	10	7	8	8	9	7¼	8
May	10	12	7½	8	8	10	7½	8
June	10½	11½	8	8	8	9	7¼	8¼
July	10½	13	7	7	8	9½	6	7½
August	13	17	7	12	9½	13½	7½	12
September	16	18½	10½	13	12½	13½	10	13
October	16	19	13	14	13½	15	12½	13
November	19	22	15	16½	15	18	14	17
December	22½	25	16½	17	18	22	17	18
1898.								
January	18	24	15	17½	15	22	12½	19
February	14	19	12	14	12½	16	10¾	14
March	10½	15¾	8	10½	8¾	12¼	8	11½
April	10	11¾	8	9	8½	10½	8	9½
May	10½	12	9	9	9	11	8½	9½
June	10½	12½	9	9	9¼	11½	8¾	9
July	13	14	9	9	9	11½	9	9
August	14½	15½	9	12	9	12½	9	13
September	15½	17½	12	13	12	14½	11½	13½
October	17½	20	13	14	13½	16½	12½	15
November	20	24	14	19	17½	22	15½	19
December	25	27	19	20	21	26	19	20
1899.								
January	17	29	14	22	15	27	13½	22
February	19	35	15	24	16	35	13½	22
March	12½	30	10½	18	11¼	20	10	17
April	12½	14½	10½	11½	11	13	10	11½
May	13¼	16	11	12	10¾	13	10¼	11½
June	14½	15½	10	11	11	13¼	10	11
July	15	16½	8½	9½	10	13	9	10
August	15	18	9	11½	10	12½	9	12
September	18	21	12½	15	11	16½	11	15½
October	20	22	15	16½	15	17	14	15½
November	21	24	17	17	17	18	16	17
December	21	24	17	17	17	20	17	17
1900.								
January	17	26	15	19	13¾	20	12½	17½
February	13½	19	12½	14	12	16	10½	14
March	12	17	9½	14	10	16	8¾	15½
April	12	13½	9½	11	10¼	11½	8¾	11½
May	12½	14½	10½	11	10¾	11½	9½	10
June	13	15	10½	10½	10	11½	8	10
July	13	17	9	10	10½	11½	7½	9½
August	14	18	9	12	11½	13½	9½	11½
September	12½	14	11½	15	13	16	16	19½
October	19	21	14	15	15½	17½	14	16½
November	20	27	18	20	18	23	16	18½
December	23	29	18	22	20	26	18	23
1901.								
January	19½	27	16	20	17	23	15½	18½
February	17	21½	14	18	14	19½	14½	17½
March	13	17½	11	14	11½	17	10½	13
April	13½	14	11	12	12	12¾	10½	12
May	13½	14½	11	11	10½	12½	10	10¾
June	13	14½	10	11	10	12	8½	10
July	14	18	9	10	10½	13	6	9
August	16	20	9	13½	12½	14½	9	11½
September	18	22	13½	17	14	17	12	16½
October	20	23	17	18	16½	19	16	18
November	22	29	18½	23	19	24	18	22
December	23	31	23	27	23	28	22	25

BEES AND PRODUCTION OF HONEY AND WAX.

About one farm in nine in the United States was reported as keeping bees in 1900. The largest total value of honey and wax produced by any State in 1899 was by Texas, $468,527. Alaska made no report and the value of the product in the District of Columbia was $56. The next lowest total was $1,149 for South Dakota.

As might be expected, the share of the Southern States in this industry is large. Several of the great agricultural States of the North, as Iowa, Illinois, and Ohio, as well as New York and Pennsylvania, take high rank in bee keeping, but they do not so overshadow such States as Arkansas and North Carolina as in the case of most agricultural industries.

The influence of climate upon bee keeping seems to be further shown by the figures from California, which stands fifth in the total value of the production of honey and wax, and in the high average production per hive of Hawaii, Arizona, Colorado, and Nevada. The low average production in the Southern States as a whole may be explained by the smaller demand and consequent falling off in attention to this along with other minor farm industries.

Bees, honey, and wax on farms and ranges, by States and Territories.

[From the Twelfth Census of the United States.]

States and Territories.	Number of farms.	Bees, honey, and wax.					
		Number of farms reporting.	Swarms of bees, June 1, 1900	Value of bees, June 1, 1900.	Pounds of honey produced in 1899.	Pounds of wax produced in 1899.	Value of honey and wax produced in 1899.
The United States...	5,739,657	707,261	4,109,626	$10,186,513	61,196,160	1,765,315	$6,664,904
Alabama	223,220	32,100	205,369	287,598	1,930,410	162,020	197,232
Arizona	5,809	489	18,991	66,603	930,420	13,080	67,489
Arkansas	178,694	22,182	111,138	204,340	1,405,320	59,340	156,943
California	72,542	6,915	120,444	363,885	3,667,738	115,330	331,939
Colorado	24,700	4,518	59,756	195,096	1,732,630	24,930	171,740
Connecticut	26,948	2,252	11,438	40,528	122,960	4,090	16,576
Delaware	9,687	1,684	10,187	20,244	101,410	1,960	10,536
District of Columbia	269	7	59	199	530	....	55
Florida	40,814	4,521	39,753	83,827	677,540	32,290	58,500
Georgia	224,691	32,246	187,919	242,769	1,650,745	73,372	169,723
Hawaii	2,273	46	1,387	8,426	96,870	1,720	8,293
Idaho	17,471	2,387	19,240	64,994	379,450	6,550	42,725
Illinois	264,151	34,932	179,953	486,164	2,961,080	75,290	343,200
Indiana	221,897	28,632	117,148	278,864	1,681,554	27,780	219,110
Indian Territory	45,505	3,021	18,227	38,425	156,100	5,190	19,091
Iowa	228,622	28,977	138,811	443,923	2,539,784	49,314	305,183
Kansas	173,098	18,295	88,594	277,967	1,187,569	19,236	151,873
Kentucky	234,667	44,974	203,820	527,098	2,681,720	53,120	291,179
Louisiana	115,969	6,148	35,231	54,316	426,490	20,440	45,200
Maine	59,299	2,406	10,857	51,459	200,080	6,570	34,461
Maryland	46,012	5,098	28,013	61,013	306,788	7,860	38,857
Massachusetts	37,715	1,799	8,381	85,751	109,050	6,250	18,412
Michigan	203,261	18,122	100,397	852,469	2,099,460	38,860	230,012
Minnesota	154,659	6,078	45,877	107,280	986,446	20,626	118,884
Mississippi	220,803	17,990	95,257	158,603	1,048,490	49,170	113,021
Missouri	284,886	41,145	205,110	508,217	3,018,929	69,258	348,604
Montana	13,370	234	1,801	8,139	19,940	130	3,706
Nebraska	121,525	12,130	52,143	199,568	866,200	16,090	105,676
Nevada	2,184	278	5,692	20,131	178,650	3,380	17,156
New Hampshire	29,324	1,288	5,520	24,665	89,260	3,350	17,686
New Jersey	34,650	2,827	14,118	89,219	174,250	7,640	23,479
New Mexico	12,311	410	6,164	20,802	189,998	2,260	18,836
New York	226,720	22,738	187,208	593,784	3,422,497	84,075	852,795
North Carolina	224,637	41,051	244,580	429,868	2,477,800	135,920	268,730
North Dakota	45,332	30	279	1,474	7,530	90	1,149
Ohio	276,719	34,458	151,391	402,561	1,980,530	34,620	252,321
Oklahoma	62,495	417	1,910	6,998	16,540	400	2,257
Oregon	35,837	8,895	55,585	160,382	979,140	16,740	109,247
Pennsylvania	224,248	28,962	161,670	531,578	2,526,202	61,302	305,292
Rhode Island	5,498	870	1,681	6,795	28,450	890	5,156
South Carolina	155,355	16,272	93,958	142,677	872,590	37,500	92,857
South Dakota	52,622	387	2,068	10,088	49,320	770	6,247
Tennessee	224,623	38,225	225,788	486,536	2,404,550	79,590	259,691
Texas	352,190	60,043	392,644	749,483	4,780,204	159,690	468,527
Utah	19,387	8,707	33,818	111,452	1,292,118	23,740	94,364
Vermont	33,104	1,878	12,836	46,953	182,278	8,652	27,290
Virginia	167,886	25,744	139,064	308,417	1,708,320	60,110	195,886
Washington	33,202	4,435	30,870	106,841	530,790	9,540	65,211
West Virginia	92,874	25,240	111,417	375,622	1,673,120	30,180	199,089
Wisconsin	169,795	10,585	106,090	377,105	2,677,100	44,670	270,742
Wyoming	6,095	158	1,020	5,822	19,220	340	2,676

WEIGHTS OF THE BUSHEL.

Legal standards for leading agricultural products in the United States.

States and Territories.	Wheat.	Rye.	Oats.	Barley.	Buckwheat.	Shelled corn.	Corn on cob.	Corn meal and rye meal.	Bran.	Malt.	Potatoes, Irish.	Potatoes, sweet.	Carrots.	Onions.	Turnips, English.	Beets.	Beans.	Peas.	Apples, peaches, pears, quinces.	Dried apples.	Dried peaches.	Castor beans.	Flaxseed.	Hemp seed.	Millet seed.	Timothy seed.	Blue-grass seed.	Hungarian grass seed.	Clover seed.	Legislative enactments.
Alabama	60	56	32	47	...	...	70	a48	...	...	60	55	...	...	55	...	60	60	...	b24	b38	...	...	...	...	...	...	...	...	Acts Feb. 18, 1891.
Alaska	60	56	32	48	42	56	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	U. S. Statute.
Arizona	60	56	32	45	...	54	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Comp. Laws, 1877.
Arkansas	60	56	32	48	52	56	70	48	20	...	60	50	...	57	57	...	60	60	50	21	33	...	56	...	50	60	14	...	60	Act Mar. 30, 1887.
California	60	54	32	50	40	52	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Code and Stat., 1886.
Colorado	60	56	32	48	52	56	70	50	...	...	60	...	...	57	...	...	60	...	...	...	...	...	...	44	...	45	14	...	60	Gen. Stat., 1883.
Connecticut	60	56	32	48	48	56	...	50	...	...	60	...	55	50	50	60	60	60	...	...	...	...	...	...	...	...	...	...	...	Gen. Stat., 1888.
Delaware	60	...	...	...	...	56	...	c48	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
District of Columbia	60	56	32	48	48	56	70	48	20	38	60	55	...	57	55	...	60	...	...	26	33	46	56	44	50	45	44	50	60	U. S. Statute.
Florida	60	56	32	48	...	56	70	48	20	...	60	60	...	56	54	...	d60	...	e48	24	33	48	...	...	50	...	...	...	...	Stat., 1901.
Georgia	60	56	32	47	52	...	70	48	20	...	60	55	...	57	55	...	60	60	...	24	38	...	56	44	...	45	14	...	60	Code, 1895.
Hawaii	60	56	32	48	42	56	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	U. S. Statute.
Idaho	60	56	36	48	42	56	...	...	...	...	60	...	...	...	...	...	...	...	b45	28	28	...	56	...	...	...	...	...	60	Code, 1901.
Illinois	60	56	32	48	52	...	70	48	20	38	60	50	...	57	55	...	60	...	...	24	33	46	56	44	...	45	14	...	60	Law, 1889.
Indiana	60	56	32	48	50	56	f68	50	...	...	60	55	...	48	55	...	60	...	...	25	33	46	...	44	50	45	14	...	60	Rev. Stat., 1901.
Indian Territory	60	56	32	48	42	56	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	U. S. Statute.
Iowa	60	56	32	48	52	...	70	...	20	...	60	46	...	57	...	...	60	...	48	24	33	46	56	44	48	45	14	48	60	Rev. Code, 1897.
Kansas	60	56	32	48	50	...	70	50	20	32	60	50	...	57	55	...	60	...	48	24	33	46	56	44	50	45	14	50	60	Gen. Stat., 1901.
Kentucky	60	56	32	47	56	56	g70	50	20	...	60	55	...	57	60	...	60	60	...	24	39	45	56	44	50	45	14	50	60	Gen. Stat., 1888.
Louisiana	60	56	32	48	...	56	72	...	...	...	...	56	...	54	58	...	60	...	...	...	...	...	...	...	50	...	...	...	...	Rev. Laws, 1884.
Maine	60	56	32	48	48	56	...	50	...	...	60	...	50	52	50	60	62	60	b44	...	...	...	...	...	...	45	...	...	...	Rev. Stat., 1883, and Acts, 1887.
Maryland	60	56	i26	48	48	56	70	50	20	34	56	56	40	56	56	50	56	56	...	28	b32	60	56	44	50	45	14	48	60	Code, 1888.
Massachusetts	60	56	32	48	48	56	...	50	20	...	60	54	50	52	...	...	60	60	48	25	33	...	55	...	k35	45	...	...	60	Rev. Laws, 1902.
Michigan	60	56	32	48	48	56	70	50	...	...	60	56	...	54	58	...	60	60	48	22	28	46	56	44	50	45	14	50	60	Annot. Stat., 1882.
Minnesota	60	56	32	48	50	56	70	...	...	...	60	55	45	52	52	50	60	60	50	28	28	...	56	50	48	45	14	48	60	Rev. Stat., 1897.
Mississippi	60	56	32	48	42	56	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Code, 1892.
Missouri	60	56	32	48	52	56	70	50	20	38	60	56	50	57	42	...	60	60	48	24	33	46	56	44	50	45	14	48	60	Rev. Stat., 1899.
Montana	60	56	32	48	52	56	70	l50	20	30	60	...	50	57	50	50	60	60	45	...	...	...	56	44	...	45	14	50	60	Stat., 1888, 1901.
Nebraska	60	56	32	48	52	56	70	50	20	30	60	50	...	57	55	...	60	60	...	24	33	46	56	44	50	45	14	50	60	Stat., 1891.
Nevada m	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
New Hampshire	60	56	32	...	...	56	...	50	...	...	60	...	...	...	...	...	60	60	...	...	...	...	...	...	...	...	...	...	...	Stat., 1891.
New Jersey	60	56	30	48	50	56	...	...	...	...	60	54	...	57	...	...	60	60	n50	25	33	...	55	...	...	...	...	...	64	Laws, 1886.
New Mexico	60	56	32	48	42	56	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Stat., 1852.
New York	60	56	32	48	48	56	...	50	20	...	60	54	50	57	...	...	60	60	48	25	33	...	55	...	...	45	...	...	60	Gen. Laws.

North Carolina	60	56	32	48	50	56	....	[a]48	....	....	....	....	....	....	....	....	....	60	....	....	....	....	55	....	....	....	....	....	60	Act, Jan. 31, 1885.
North Dakota	60	56	32	48	42	56	70	....	20	....	60	46	50	52	60	60	60	60	....	....	....	....	56	44	50	42	14	48	60	Code, 1899.
Ohio	60	56	32	48	50	56	68	....	....	34	60	50	50	55	60	56	60	60	[p]48	24	33	....	56	44	50	45	....	50	60	Act, 1893.
Oklahoma	60	56	32	48	42	56	70	....	....	....	60	46	....	52	60	60	60	60	....	....	....	46	56	....	50	42	....	....	60	Laws, 1893.
Oregon	60	56	32	46	42	56	....	....	....	....	60	....	....	....	....	....	....	....	45	28	28	....	....	....	....	....	....	....	60	Laws, 1901.
Pennsylvania	60	56	32	47	48	56	....	....	....	....	56	....	....	50	....	....	....	....	....	....	....	....	....	....	....	....	....	....	60	Digest, 1883.
Philippines	60	56	32	48	42	56	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	U. S. Statute.
Porto Rico	60	56	32	48	42	56	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	U. S. Statute.
Rhode Island	60	56	32	48	40	56	72	50	25	....	60	50	50	50	50	50	60	60	....	....	....	....	50	40	50	45	14	48	60	Gen. Laws, 1896.
Samoa	60	56	32	48	42	56	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	U. S. Statute.
South Carolina	60	56	32	48	42	56	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	U. S. Statute.
South Dakota	60	56	32	48	42	56	70	....	20	....	60	46	....	52	60	60	60	60	....	....	....	....	56	....	....	42	....	....	60	Laws, 1887.
Tennessee	60	56	32	48	50	56	70	50	20	....	60	50	30	56	50	50	60	30	50	24	26	46	56	44	50	45	14	48	60	Act, 1887.
Texas	60	56	32	48	42	56	70	....	20	....	60	55	....	57	55	....	60	....	....	....	28	....	56	44	50	45	....	48	60	Act, Apr. 10, 1883.
Utah	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	
Vermont	60	56	32	48	48	56	....	....	....	....	60	....	50	52	52	60	62	60	46	....	....	....	....	....	....	45	....	....	60	Laws, 1880, 1884.
Virginia	60	56	32	48	52	56	70	50	....	38	56	56	....	57	55	....	60	60	....	28	[q]40	....	56	44	50	45	14	48	60	Code, 1887.
Washington	60	56	36	48	42	56	....	(r)	(r)	(r)	60	(s)	(s)	(s)	(s)	(s)	(s)	(s)	45	28	28	....	56	....	....	....	....	....	60	Stat., 1897.
West Virginia	60	56	32	48	52	56	....	....	....	....	60	....	....	....	....	....	....	....	....	25	33	....	56	....	....	45	....	....	60	Code, 1887.
Wisconsin	60	56	32	48	48	56	70	50	....	34	60	54	50	57	42	50	60	60	48	25	33	....	55	44	50	45	....	48	60	Laws, 1881.
Wyoming	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	Laws, 1899.

[a] Bolted, 46.
[b] Peeled.
[c] Sifted, 44.
[d] Velvet beans in hull, 78.
[e] Pears, 60.
[f] Before Dec. 1, 70.
[g] May 1 to Nov. 1, 68.
[h] Apples and pears.
[i] Trade usage, 32.
[k] Japanese barnyard millet.
[l] Cornmeal.
[m] No laws.
[n] Apples.
[o] Bolted corn meal, 48.
[p] Apples, 50.
[q] Unpeeled, 32.
[r] Sold by 2,000 pounds or sack
[s] Sold by ton or 100 pounds.

NOTE.—The figures given for Alaska, Hawaii, Indian Territory, the Philippines, Porto Rico, and Samoa are from the United States Revised Statutes of 1878, and are fixed for the customs service. The same figures are given for Mississippi, New Mexico, and South Carolina under the State and Territory laws noted. The figures for California have not been verified by any report from that State.

TRANSPORTATION RATES.[a]

Grain; average rates, in cents per bushel, from St. Louis to New Orleans by river.

Year.	Grain in sacks, per 100 pounds.	Per bushel.			Year.	Grain in sacks, per 100 pounds.	Per bushel.		
		Wheat in bulk.	Corn and rye.				Wheat in bulk.	Corn and rye.	
			High water.	Low water.				High water.	Low water.
1866			9.05	10.93	1884	14	6.63	5	7
1867			11.09	14.83	1885	15	6.40	5	7
1868			6.23	9.84	1886	16	6.50	5	7
1869			6.32	8.42	1887	18.25	6	5	7
1870			9.23	13.66	1888	15	6.50	5	7.50
1871			6.71	16.29	1889	17.93	5.95	5	7
1872			9.79	19.04	1890	15.66	6.58	5	7
1873			6.15	9.67	1891	16.28	6.88	5	7.50
1874			4.95	8.09	1892	16.87	6.50	5	7
1875			4.87	10.01	1893	17.54	6.55		
1876			5.02	11.30	1894	17.14	5.89		
1877	20.04	8.11	7.63	8.59	1895	12.50	5.95		
1878	17.36	7.19	4.96	8.93	1896	14.55	5		
1879	18	7.75	5	11	1897	15	4.98		
1880	19	8.25	7	9.50	1898	10	4.50		
1881	20	6	4	8	1899	10	4.50		
1882	20	6.42	5.50	7	1900	10	4.25		
1883	17.75	5.50	5	7	1901	10	4.25		

Miscellaneous commodities, New York to Chicago by rail.[b]

AVERAGE RATES FOR LESS THAN CARLOAD QUANTITIES, IN CENTS PER 100 POUNDS.

Year.	Furniture.	Agricultural implements.	Lead.	Bagging.	Crockery and earthenware.	Coffee.	Starch.	Sugar.	Molasses.	Rice.	Soap.	
											Castile and fancy.	Common.
1875	53		25	48	29	24	40	24	41	25	48	33
1876	39		20	37	20	20	32	20	23	20	37	23
1877	72		33	56	33	33	50	33	40	33	65	40
1878	77		41	41	41	41	41	41	41	41	62	41
1879	75		40	40	40	40	40	40	40	40	60	40
1880	75		40	40	40	40	40	40	40	40	60	40
1881	65		33	33	33	33	33	33	33	33	51	33
1882	56		26	26	26	26	26	24	24	26	44	26
1883	75		35	35	35	35	35	30	30	35	60	35
1884	75		35	35	35	35	35	25	25	35	60	35
1885	56		27	27	27	27	27	20	20	27	45	27
1886	75		35	35	35	35	35	25	25	35	60	35
1887	75		35	46	35	35	35	33	33	35	64	35
1888	73	49	35	49	35	35	35	35	35	35	68	35
1889	75	50	35	50	35	35	35	35	35	35	65	35
1890	75	50	35	50	35	35	35	35	35	35	65	35
1891	75	50	35	50	35	35	35	35	35	35	49	35
1892	75	50	35	50	35	35	35	35	35	35	35	35
1893	75	50	35	50	35	35	35	35	35	35	35	35
1894	75	50	35	50	35	35	35	35	35	35	35	35
1895	75	50	35	50	35	35	35	35	35	35	35	35
1896	75	50	35	50	35	35	35	35	35	35	35	35
1897	75	50	35	50	35	35	35	35	35	35	35	35
1898	75	50	35	50	35	35	35	35	35	35	35	35
1899	75	50	35	50	35	35	35	35	35	35	35	35
1900	75	57	35	57	42	42	42	35	42	35	42	42
1901	75	57	35	57	42	42	42	35	42	35	42	42

[a] All figures here presented are upon a gold basis, the currency rates in actual use prior to the resumption of specie payments having been reduced to their gold equivalents.

[b] Rates for earlier years for this and succeeding tables of transportation rates can be found in Bulletin 15, Miscellaneous Series, Division of Statistics, Department of Agriculture.

Live stock and dressed meats, Chicago to New York by rail.

AVERAGE RATES, IN CENTS PER 100 POUNDS.

Year.	Cattle.	Hogs.	Sheep.	Horses and mules.	Dressed beef.	Dressed hogs.	
						Refrigerator cars.	Common cars.
1880	55	43	65	60	88	....	....
1881	35	31	61	60	56	....	....
1882	36	29	53	60	57	....	....
1883	40	32	50	60	64	....	....
1884	31	28	44	60	51	....	....
1885	31	26	43	60	54	....	....
1886	33	30	42	60	61	53	48
1887	33	32	40	60	62	59	54
1888	22	26	31	60	46	46	44
1889	25	30	30	60	47	47	45
1890	23	28	30	60	39	39	39
1891	27	30	30	60	45	45	45
1892	28	28	30	60	45	45	45
1893	28	20	30	60	45	45	45
1894	28	30	30	60	45	45	45
1895	28	30	30	60	45	45	45
1896	28	30	30	60	45	45	45
1897	28	30	30	60	45	45	45
1898	28	30	30	60	45	45	45
1899	[a]25	25	25	60	40	40	40
1900	28	30	30	60	45	45	45
1901	28	30	30	60	42.9	42.9	42.9

[a] Rates did not go into effect until February 1, 1899. Until that time the 1898 rates governed.

Meats packed, Cincinnati to New York by rail.

AVERAGE RATES, IN CENTS PER 100 POUNDS.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	The year.
1880	39.0	39.0	39.0	34.5	30.5	30.5	30.5	30.5	30.5	30.5	31.5	35.0	33.41
1881	35.0	35.0	35.0	30.5	30.5	25.7	21.5	21.5	21.5	21.5	21.5	21.5	26.73
1882	......	21.5	24.3	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	30.5	25.85
1883	30.5	30.5	30.5	29.2	26.0	26.0	26.0	26.0	26.0	26.0	26.7	30.5	27.83
1884	30.5	30.5	23.3	17.5	17.5	18.4	23.0	26.0	26.0	26.0	26.0	26.0	24.22
1885	24.4	21.5	20.0	20.6	18.5	17.5	17.5	21.5	21.5	21.5	22.8	26.0	21.10
1886	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	27.7	26.14
1887	30.5	30.5	30.5	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	27.12
1888	28.0	28.5	26.3	26.0	26.0	26.0	19.9	17.3	15.5	18.8	21.5	23.6	23.11
1889	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.00
1890	26.0	26.0	26.0	26.0	26.0	26.0	26.0	24.8	20.0	20.0	20.0	20.0	23.89
1891	20.0	24.3	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	25.36
1892	26.0	26.0	26.0	26.0	26.0	25.7	21.5	21.5	21.5	21.5	21.5	21.5	23.70
1893	21.5	23.7	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	25.48
1894	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.00
1895	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.00
1896	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.00
1897	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.00
1898	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.00
1899	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	21.5	21.5	21.5	24.88
1900	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.00
1901	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.00

Miscellaneous commodities, New York to Chicago by rail.

AVERAGE RATES FOR CARLOADS, IN CENTS PER 100 POUNDS.

Year.	Furniture.	Agricultural implements.	Lead.	Bagging.	Crockery and earthenware.	Coffee.	Starch.	Sugar.	Molasses.	Rice.	Soap.	
											Castile and fancy.	Common.
1875	53	33	25	48	29	24	40	24	41	25	48	33
1876	39	23	20	37	20	20	32	20	23	20	37	23
1877	72	39	33	56	33	33	50	33	40	33	65	40
1878	77	41	41	41	41	41	41	41	41	41	62	41
1879	75	40	40	40	40	40	40	40	40	40	60	40
1880	75	40	40	40	40	40	40	40	40	40	60	40
1881	65	33	33	33	33	33	33	33	33	33	51	33
1882	56	26	26	26	26	26	26	24	24	26	44	26
1883	75	36	35	35	35	35	35	30	30	35	60	35
1884	75	36	35	35	35	35	35	25	25	35	60	35
1885	56	27	27	27	27	27	27	20	20	27	45	27
1886	75	35	35	35	35	35	35	25	25	35	60	35
1887	67	31	27	35	31	27	27	25	29	35	64	31
1888	63	30	25	35	30	25	25	25	30	25	63	30
1889	65	30	25	35	30	25	25	25	30	25	65	30
1890	65	30	25	35	30	25	25	25	30	25	65	30
1891	65	30	25	35	30	25	25	25	30	25	41	26
1892	65	30	25	35	30	25	25	25	30	25	25	25
1893	65	30	25	35	30	25	25	25	30	25	25	25
1894	65	30	25	35	30	25	25	25	30	25	25	25
1895	65	30	25	35	30	25	25	25	30	25	25	25
1896	65	30	25	35	30	25	25	25	30	25	25	25
1897	65	30	25	35	30	25	25	25	30	25	25	25
1898	65	30	25	35	30	25	25	25	30	25	25	25
1899	65	30	25	35	30	25	25	25	30	25	25	25
1900	65	30	25	35	30	30	30	30	30	25	30	30
1901	65	30	25	35	30	30	30	30	30	25	30	30

AVERAGE RATES, REGARDLESS OF QUANTITY SHIPPED, IN CENTS PER 100 POUNDS.

Year.	Dry goods.	Cotton piece goods.	Boots and shoes.	Tea.	Drugs.
1875	53	53	53	53	53
1876	39	39	39	39	39
1877	72	72	72	72	72
1878	77	77	77	77	77
1879	75	75	75	75	75
1880	75	75	75	75	75
1881	65	65	65	65	65
1882	56	56	56	56	56
1883	75	75	75	75	75
1884	75	75	75	75	75
1885	56	56	56	56	56
1886	75	66	75	75	75
1887	75	50	75	75	75
1888	73	49	73	73	73
1889	75	50	75	75	75
1890	75	50	75	75	75
1891	75	50	75	75	75
1892	75	50	75	75	75
1893	75	50	75	75	75
1894	75	50	75	75	75
1895	75	50	75	75	75
1896	75	50	75	75	75
1897	75	50	75	75	75
1898	75	50	75	75	75
1899	75	50	75	75	75
1900	75	57	75	75	75
1901	75	57	75	75	75

Average freight rates, in cents per ton per mile.

Year.	Fitchburg R. R.	Boston and Albany R. R.	New York Central and Hudson River R. R.	Erie R. R.	Lake Shore and Michigan Southern Rwy.	Pennsylvania R. R.	Pittsburg, Fort Wayne and Chicago Rwy.	Chesapeake and Ohio Rwy.	Illinois Central R. R.	Chicago, Rock Island and Pacific Rwy.	Chicago, Milwaukee and St. Paul Rwy.	Chicago and Alton R. R.	Union Pacific Rwy.	Louisville and Nashville R. R.	All railways in the United States.
1875....	3.624	1.316	1.119	1.061	0.887	0.989	0.970	1.299	1.691	1.688	1.833	1.649	2.164	1.687	1.421
1876....	2.218	1.139	.929	.972	.722	.841	.827	1.062	1.587	1.693	1.798	1.438	2.211	1.638	1.217
1877....	1.955	1.136	.954	.898	.813	.954	1.021	1.035	1.719	1.563	1.949	1.361	2.135	1.382	1.286
1878....	1.582	1.113	.919	.960	.724	.914	.867	.985	1.616	1.539	1.762	1.354	2.236	1.635	1.296
1879....	1.299	1.100	.793	.779	.641	.823	.754	.860	1.523	1.429	1.701	1.054	1.991	1.528	1.153
1880....	1.36	1.207	.879	.836	.750	.918	......	.866	1.543	1.209	1.749	1.206	......	1.594	1.232
1881....	1.26	1.038	.783	.805	.617	.857	.745	.892	1.522	1.220	1.702	1.211	2.178	1.503	1.188
1882....	1.17	1.061	.738	.749	.628	.874	.752	.753	1.417	1.281	1.481	1.253	2.102	1.349	1.102
1883....	1.19	1.197	.915	.786	.728	.881	.787	.722	1.433	1.170	1.391	1.128	1.913	1.323	1.205
1884....	1.09	1.093	.831	.719	.652	.804	.673	.672	1.368	1.097	1.293	1.008	1.557	1.344	1.136
1885....	1.06	.911	.688	.656	.553	.695	.577	.550	1.307	1.043	1.278	1.009	1.420	1.159	1.011
1886....	1.07	1.101	.765	.659	.639	.755	.692	.541	1.157	1.071	1.168	.961	1.266	1.079	.999
1887....	1.13	1.107	.782	.687	.670	.730	.717	.537	1.087	1.012	1.089	.946	1.218	1.075	.981
1888....	1.116	1.099	.753	.716	.861	.723	.660	.541	1.068	.964	1.020	.973	1.170	1.049	1.001
1889....	1.015	1.030	.712	.644	.632	.685	.69	.538	.839	.971	1.067	.525	1.166	.998	.922
1890....	.995	1.105	.730	.665	.614	.661	.69	.561	.942	.995	.995	.898	1.138	.972	.941
1891....	.991	1.089	.740	.636	.630	.656	.70	.525	.931	1.039	1.003	.980	1.131	.968	.895
1892....	.925	1.057	.699	.614	.602	.647	.67	.518	.908	1.055	1.026	.973	1.080	.948	.898
1893....	.923	1.006	.701	.631	.599	.620	.68	.511	.845	1.039	1.026	.949	1.033	.917	.878
1894....	.895	.914	.733	.621	.587	.606	.65	.478	.839	.989	1.037	.974	.970	.876	.860
1895....	.878	.969	.726	.604	.567	.565	.61	.425	.808	1.084	1.075	.994	.971	.831	.839
1896....	.861	.942	.668	.606	.551	.563	.66	.425	.715	1.017	1.003	.925	.957	.806	.806
1897....	.870	.918	.679	.610	.538	.561	.60	.419	.671	.958	1.008	.891	.962	.791	.798
1898....	.844	.839	.606	.575	.530	.521	.57	.369	.695	.966	.972	.866	.950	.713	.753
1899....	.771	.778	.586	.539	.481	.469	.50	.362	.688	.996	.937	.800	1.016	.727	.724
1900....	.798	.821	.558	.588	.490	.501	.58	.343	.650	.987	.930	.794	1.050	.752	.729

Average rates, in cents per passenger per mile.

Year.	Fitchburg R. R.	Boston and Albany R. R.	New York Central and Hudson River R. R.	Erie R. R.	Lake Shore and Michigan Southern Rwy.	Pennsylvania R. R.	Pittsburg, Fort Wayne and Chicago Rwy.	Chesapeake and Ohio Rwy.	Illinois Central R. R.	Chicago, Rock Island and Pacific Rwy.	Chicago, Milwaukee and St. Paul Rwy.	Chicago and Alton R. R.	Union Pacific Rwy.	Louisville and Nashville R. R.	All railways in the United States.
1875....	1.910	2.180	1.885	1.955	2.088	2.259	2.407	3.281	2.882	2.687	2.690	2.755	2.878	3.219	2.378
1876....	1.861	2.099	1.693	1.859	1.816	1.819	1.830	3.322	2.801	2.626	2.805	2.614	2.974	3.018	2.183
1877....	1.947	2.174	1.953	1.772	2.182	2.185	2.192	3.786	2.942	2.772	2.904	2.798	3.140	3.107	2.458
1878....	1.969	2.217	1.978	2.158	2.255	2.277	2.258	3.738	3.122	2.933	3.029	2.795	3.220	3.345	2.573
1879....	1.888	2.137	2.044	2.090	2.221	2.258	2.228	3.630	3.066	2.971	2.908	2.417	......	3.444	2.484
1880....	1.885	2.096	1.999	2.011	2.135	2.222	2.156	2.950	2.514	2.806	2.868	2.076	......	3.476	2.442
1881....	1.820	1.970	1.862	2.016	1.988	2.152	1.895	2.989	2.164	2.666	2.856	1.828	3.341	3.168	2.446
1882....	1.715	1.993	1.808	1.918	2.156	2.219	2.021	2.605	2.388	2.505	2.579	1.951	3.300	2.706	2.391
1883....	1.790	2.088	1.986	1.673	2.196	2.297	2.193	2.373	2.424	2.504	2.516	2.141	3.128	2.614	2.402
1884....	1.651	1.908	1.942	2.189	2.170	2.258	2.222	2.379	2.225	2.572	2.553	1.900	2.952	2.342	3.323
1885....	1.833	1.838	1.419	1.756	2.058	1.950	1.569	2.270	2.211	2.466	2.563	2.026	2.749	2.103	2.216
1886....	1.756	1.853	1.845	1.890	2.098	2.114	2.130	2.131	2.208	2.420	2.415	2.023	2.135	2.436	2.142
1887....	1.89	1.880	1.989	2.039	2.260	2.125	2.255	2.074	2.268	2.328	2.538	2.062	2.301	2.394	2.245
1888....	1.978	1.976	1.967	1.851	2.280	2.111	2.10	2.025	2.197	2.312	2.415	2.123	2.248	2.429	2.349
1889....	1.957	1.869	1.932	1.722	2.286	2.076	2.18	1.709	1.927	2.285	2.415	2.128	2.135	2.370	2.165
1890....	1.915	1.858	1.910	1.584	2.251	2.094	2.25	2.056	2.022	2.149	2.359	2.004	2.045	2.403	2.167
1891....	1.869	1.818	1.905	1.601	2.105	2.070	2.23	2.155	2.073	2.322	2.408	2.205	2.059	2.483	2.142
1892....	1.916	1.828	1.887	1.589	2.183	2.028	2.00	2.181	2.101	2.308	2.464	2.043	2.104	2.448	2.126
1893....	1.860	1.835	1.832	1.551	2.195	1.968	1.98	1.989	1.999	2.095	2.414	1.981	1.987	2.432	2.108
1894....	1.851	1.794	1.857	1.509	2.069	1.993	2.00	1.905	1.925	1.891	2.191	1.776	1.758	2.365	1.986
1895....	1.819	1.770	1.837	1.560	2.215	1.971	2.06	1.980	1.995	2.146	2.411	2.119	1.962	2.318	2.040
1896....	1.769	1.752	1.838	1.641	2.148	1.950	1.88	1.952	1.979	2.108	2.375	2.117	2.075	2.187	2.019
1897....	1.811	1.754	1.842	1.543	2.108	1.958	2.02	1.960	1.979	2.153	2.289	2.116	2.101	2.254	2.022
1898....	1.826	1.750	1.806	1.548	2.082	*1.953	2.02	1.943	1.938	2.092	2.362	2.058	1.945	2.152	1.973
1899....	1.800	1.744	1.766	1.586	2.074	*1.937	2.02	1.860	2.014	2.036	2.337	2.055	1.941	2.243	1.925
1900....	1.805	1.754	1.798	1.540	2.223	1.952	2.05	1.973	2.021	2.064	2.316	1.908	1.968	2.318	2.003

*Excludes ferry earnings at Jersey City, N. J.

IMPORTS AND EXPORTS OF AGRICULTURAL PRODUCTS.

[From Section of Foreign Markets.]

Agricultural imports of the United States during the five years ended June 30, 1901.

Articles imported.	1897.		1898.		1899.		1900.		1901.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
ANIMAL MATTER.										
Animals, live:										
Cattle......number..	328,977	$2,589,857	291,589	$2,913,223	199,752	$2,320,362	181,006	$2,257,694	146,022	$1,931,433
Horses......do....	6,998	464,808	3,085	414,899	3,042	551,050	3,102	596,592	3,785	985,738
Sheep......do....	405,633	1,019,668	392,314	1,106,322	345,911	1,200,081	381,792	1,365,026	331,488	1,236,277
Other, including fowls......	....	211,122	....	239,681	....	265,032	....	311,638	....	325,507
Total......	....	4,285,455	....	4,674,125	....	4,336,525	....	4,530,950	....	4,478,955
Beeswax......pounds..	174,017	43,339	272,097	72,473	452,016	109,957	213,813	51,526	213,773	55,884
Bones, hoofs, and horns:										
Bones, crude......	....	224,039	....	492,544	....	704,959	....	830,063	....	674,368
Hoofs and horns......	....	150,134								
Total......	....	374,173	....	492,544	....	704,959	....	830,063	....	674,368
Bristles:										
Crude......pounds..	630	385	1,203	416	21,421	12,399	27,140	22,330	51,539	22,310
Sorted, bunched, or prepared....do....	1,347,270	1,216,794	1,533,887	1,248,703	1,835,156	1,445,853	2,503,018	2,130,537	1,633,036	1,707,887
Total......do....	1,347,900	1,217,179	1,535,090	1,249,119	1,856,577	1,458,252	2,530,158	2,152,867	1,684,575	1,730,197
Dairy products:										
Butter......do....	37,963	6,077	31,984	5,474	23,700	3,962	49,791	9,769	93,669	19,441
Cheese......do....	12,319,122	1,668,796	10,012,188	1,343,173	11,826,175	1,563,128	13,455,990	1,761,613	15,329,099	2,120,293
Milk......	....	58,467	....	67,729	....	52,603	....	42,686	....	48,062
Total......	....	1,733,340	....	1,416,376	....	1,619,693	....	1,814,068	....	2,187,796
Eggs......dozens..	580,681	47,760	166,319	8,078	225,180	21,300	135,038	8,741	126,520	10,515
Egg yolks......	....	(a)	....	(a)	....	11,322	....	19,591	....	246
Feathers and downs, crude......	....	2,232,908	....	2,238,955	....	1,768,092	....	1,736,458	....	1,524,859

Fibers, animal:										
Silk—										
Cocoons ....pounds..	....	....	10,492	3,999	13,537	2,288	30,004	18,235	132	139
Raw, or as reeled from the cocoon, pounds..........................	6,513,612	18,496,944	10,315,162	31,446,800	9,691,145	31,827,061	11,259,310	44,549,672	9,139,617	29,353,777
Waste ....pounds..	1,479,832	421,339	1,762,297	659,267	1,545,701	650,278	1,784,404	761,853	1,265,806	697,449
Total silk..................do....	7,993,444	18,918,283	12,087,951	32,110,066	11,250,383	32,479,627	13,073,718	45,329,760	10,405,555	30,051,365
Wools and hair of the camel, goat, alpaca, and other like animals—										
Class 1, clothing—										
In the grease.........pounds..	176,350,510	27,824,507	43,061,372	7,302,841	12,973,444	1,948,402	37,404,243	8,009,985	30,681,475	5,025,194
Scoured ....do....	24,408,569	6,457,149	2,381,615	666,770	3,555	552				
Total class 1...........do....	200,759,079	34,281,656	45,442,987	7,969,611	12,976,999	1,948,954	37,404,243	8,009,985	30,681,475	5,025,194
Class 2, combing—										
In the grease............do....	37,627,967	7,119,201	4,305,563	856,381	2,154,232	586,865	12,631,283	2,633,721	5,484,264	1,074,701
Scoured ....do....	323,523	68,419	15,310	3,218	1,187	196				
Total class 2...........do....	37,951,490	7,187,620	4,320,873	859,599	2,155,419	587,061	12,631,283	2,633,721	5,484,264	1,074,701
Class 3, carpet—										
In the grease............do....	110,665,432	11,599,886	83,027,666	7,954,159	61,578,547	5,784,444	105,892,929	9,617,230	67,417,766	6,429,986
Scoured ....do....	1,476,025	174,029	3,676	323	25,244	2,438				
Total class 3...........do....	112,141,457	11,773,915	83,031,342	7,954,482	61,603,791	5,786,882	105,892,929	9,617,230	67,417,766	6,429,986
Total wools............do....	350,852,026	53,243,191	132,795,202	16,783,692	76,736,209	8,322,897	155,928,455	20,260,936	103,583,505	12,529,881
Total animal fibers	....	72,161,474	....	48,893,758	....	40,802,524	....	65,590,696	....	42,581,246
Gelatin	....	5,748	....	25,907	....	21,961	....	30,361	....	23,230
Glue...........................pounds..	4,926,620	472,312	4,103,814	428,507	5,358,063	479,450	5,577,082	537,492	4,540,951	473,341
Grease [b]	....	984,332	....	593,239	....	696,674	....	779,666	....	756,453
Gut	....	180,721	....	42,879	....	15,905	....	13,138	....	1,826
Hair	....	1,330,632	....	1,839,668	....	1,814,964	....	2,445,964	....	1,611,424
Hide cuttings and other glue stock	....	289,686	....	408,262	....	708,968	....	1,223,521	....	1,057,931
Hides and skins,[c] other than furs:										
Goatskins ....pounds..	49,868,020	11,328,162	64,923,487	15,776,601	69,728,945	18,488,326	81,998,818	21,987,674	73,745,596	20,577,033
Hides of cattle [d] ....do....	(a)	(a)	126,243,595	13,624,989	130,396,020	13,621,946	163,865,165	19,408,217	129,174,624	14,647,413
Other [e] ....do....	156,232,824	16,534,864	54,607,534	7,667,342	66,965,785	9,877,771	100,070,795	16,539,807	77,989,617	12,995,567
Total ....do....	206,100,844	27,863,026	245,774,616	37,068,932	267,090,750	41,988,043	345,934,778	57,935,698	280,909,837	48,220,913
Honey.......................gallons..	66,432	27,599	96,604	38,158	126,217	51,599	146,860	70,857	182,196	83,599

[a] Not stated.
[b] Prior to July 24, 1897, including tallow, subsequently classed under "Other meat products" (dutiable).
[c] Except sheepskins with the wool on.
[d] Exclusive of hides of cattle, free under reciprocity treaty with Hawaii.
[e] Prior to 1899, including bird skins and fishskins.

Agricultural imports of the United States during the five years ended June 30, 1901—Continued.

Articles imported.	1897.		1898.		1899.		1900.		1901.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
ANIMAL MATTER—continued.										
Meat products:										
Meat and meat extracts		$601,808		$345,108		$263,845		$365,589		$407,003
Sausage, Bologna ..... pounds	328,080	76,303	(a)	82,546	(a)	93,714	(a)	95,944	(a)	80,605
Sausage casings		542,817		537,871		622,949		646,889		642,212
Other [b]		49,484		80,031		114,843		106,163		54,667
Total		1,270,412		1,045,556		1,095,351		1,214,585		1,184,487
Oils, animal, except whale and fish, gallons	38,334	6,066	14,163	5,715	9,056	1,569	18,050	3,255	59,131	12,858
Rennets		60,026		90,757		93,284		66,907		88,744
Stearin ..... pounds	(a)	(a)	(a)	(a)	1,865,977	25,546	1,524,722	27,895	3,684,720	67,686
Total animal matter		114,586,188		100,633,008		97,825,938		141,084,302		106,825,658
VEGETABLE MATTER.										
Argols, or wine lees ..... pounds	23,457,576	1,967,042	19,202,629	1,591,027	23,300,762	1,914,450	27,339,489	2,388,693	28,598,781	2,476,482
Breadstuffs:										
Barley ..... bushels	1,271,787	394,749	124,804	43,863	110,475	53,696	189,757	91,040	171,004	84,073
Corn (maize) ..... do	6,284	2,070	3,417	1,479	4,171	1,618	2,480	1,942	5,163	3,418
Oats ..... do	46,459	12,071	9,098	3,368	11,500	4,432	41,523	18,360	20,735	8,995
Oatmeal ..... pounds	1,525,409	32,742	287,910	15,697	298,764	17,740	234,959	13,499	204,694	11,667
Rye ..... bushels	72	170	32,938	13,323	402	982	330	366	46	33
Wheat ..... do	1,534,117	1,176,337	2,046,590	1,948,289	1,871,101	1,407,625	316,968	240,496	600,212	418,327
Wheat flour ..... barrels	2,250	9,914	2,744	12,230	905	4,057	717	3,771	642	3,430
Other, and preparations of, used as food		1,146,710		1,113,818		1,054,615		1,494,255		1,522,328
Total		2,774,763		3,152,067		2,541,765		1,803,729		2,052,271
Broom corn ..... tons	(a)	(a)	(a)	(a)	(a)	(a)	549	49,612	6	618
Chocolate, prepared or manufactured, not including confectionery ..... pounds	1,467,977	239,819	992,288	149,866	1,124,515	201,439	1,209,012	240,141	718,848	141,892
Cider ..... gallons	(a)	(a)	(a)	(a)	(a)	(a)	2,647	2,287	4,376	3,496
Cocoa:										
Crude, and leaves and shells of, pounds	31,406,612	2,997,866	25,717,404	3,492,033	35,512,364	5,064,703	41,746,872	5,657,283	45,924,353	6,472,829
Prepared or manufactured ..... pounds	1,495,459	443,604	815,824	290,844	926,219	295,413	1,012,368	313,561	977,003	288,840
Total ..... do	32,902,071	3,441,470	26,533,228	3,782,877	36,438,583	5,360,116	42,759,240	5,970,844	46,901,356	6,761,669

Coffee ....do....	737,645,670	81,544,384	870,514,455	65,067,631	831,827,063	55,275,470	787,991,911	52,467,943	854,871,310	62,861,399
Coffee substitutes:										
Chicory root—										
Raw, unground ....do....	16,930,162	232,494	315,707	5,100	159,269	2,353	1,216,518	17,762	511,693	9,833
Roasted, ground, or otherwise prepared ....pounds..	399,008	13,899	(a)	(a)	335,347	11,061	384,957	12,941	348,597	11,098
Total chicory root ....do....	17,329,170	246,393	(a)	(a)	494,616	13,414	1,601,475	30,703	860,290	20,931
Other ....do....	2,373,245	87,679	857,810	29,562	992,395	36,370	1,262,659	49,029	875,420	38,354
Total coffee substitutes....do....	19,702,415	334,072	(a)	(a)	1,487,011	49,784	2,864,134	79,732	1,735,710	59,285
Curry and curry powder	....	(a)	....	(a)	....	7,383	....	8,770	....	7,497
Fibers, vegetable:										
Cotton ....pounds..	51,898,926	5,884,262	52,660,363	5,019,503	56,155,158	5,013,146	67,398,521	7,960,945	46,631,283	6,757,828
Flax ....tons..	9,190	1,897,976	5,529	1,193,597	6,474	1,306,520	6,967	1,646,274	6,878	1,880,717
Hemp ....do....	5,120	639,857	4,017	560,334	3,941	477,108	3,400	450,269	4,037	622,814
Istle, or Tampico fiber ....do....	6,313	335,841	2,563	130,294	4,410	284,177	5,748	475,690	2,334	163,566
Jute and jute butts ....do....	68,550	1,640,484	112,306	2,543,498	83,161	2,296,159	102,693	3,956,413	103,140	4,412,482
Manila hemp ....do....	46,260	3,408,322	50,270	3,239,341	53,195	6,211,475	42,624	7,172,368	43,785	7,115,446
Sisal grass ....do....	63,266	3,834,732	69,322	5,169,900	71,898	9,211,377	76,921	11,782,263	70,076	7,972,564
Other ....do....	8,734	579,206	9,791	609,222	7,466	513,247	10,953	891,128	8,013	764,917
Total	....	18,220,680	....	18,465,689	....	25,313,239	....	34,334,750	....	29,720,334
Flowers, natural, preserved or fresh [c]	....	10,334	....	11,914	....	19,392	....	30,621	....	21,268
Fruit juices, n. e. s:										
Prune juice or prune wine ....gallons..	34,546	24,222	26,174	23,285	35,047	27,204	40,761	33,215	37,686	26,885
Other, including cherry juice....do....	(a)	56,767	52,968	25,879	44,841	23,173	48,727	30,087	42,152	20,989
Total ....do....	(a)	80,989	79,142	49,164	79,888	50,377	89,488	63,302	79,838	47,874
Fruits and nuts:										
Fruits—										
Bananas	....	4,086,320	....	4,236,418	....	5,665,588	....	5,877,835	....	6,550,186
Currants ....pounds..	29,265,761	596,084	25,186,210	837,987	30,849,253	798,357	36,251,779	916,908	16,049,198	916,994
Dates ....do....	11,847,279	284,056	13,561,434	371,992	12,943,305	324,087	19,902,512	410,349	18,434,917	372,400
Figs ....do....	8,940,762	535,380	9,628,426	509,002	7,284,058	356,762	8,812,487	513,895	9,933,871	458,513
Lemons ....do....	(a)	4,043,822	(a)	2,848,130	225,942,718	4,398,004	160,198,056	3,666,881	148,514,614	3,516,856
Oranges ....do....	(a)	2,324,907	(a)	886,722	83,497,669	1,097,596	68,618,938	1,087,041	50,332,914	716,457
Plums and prunes....do....	710,028	73,303	303,992	39,660	600,360	63,574	443,457	47,700	745,974	62,880

[a] Not stated.

[b] Exclusive of tallow (free of duty) prior to July 24, 1897. In 1899 and 1900, including "Tallow, under reciprocity treaty with Hawaii (free)," of which 142,050 pounds, valued at $5,196, were imported in 1899, and 10,690 pounds, valued at $437, in 1900.

[c] Exclusive of natural flowers free of duty. Since July 24, 1897, all natural flowers imported have been dutiable.

Agricultural imports of the United States during the five years ended June 30, 1901—Continued.

Articles imported.	1897.		1898.		1899.		1900.		1901.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Fruits and nuts—Continued.										
Fruits—Continued.										
Raisins ....pounds..	12,650,598	$567,039	6,593,833	$381,889	4,933,201	$282,400	10,309,498	$531,124	3,860,836	$297,631
Prepared or preserved fruits	....	605,053	....	922,357	....	1,020,644	....	1,243,479	....	1,366,801
Other[a]	....	1,810,807	....	1,294,855	....	1,579,652	....	1,989,546	....	2,059,130
Total fruits[a]	....	14,926,771	....	12,329,012	....	15,586,664	....	16,284,758	....	16,317,848
Nuts—										
Almonds ....pounds..	9,644,338	880,263	5,746,362	659,659	9,957,427	1,222,587	6,317,633	949,083	5,140,232	946,138
Cocoanuts	....	471,387	....	575,935	....	625,789	....	702,947	....	804,233
Other[b]	....	848,511	....	1,002,344	....	879,166	....	1,326,804	....	1,518,484
Total nuts[b]	....	2,200,161	....	2,237,938	....	2,727,542	....	2,978,834	....	3,268,855
Total fruits and nuts	....	17,126,932	....	14,566,950	....	18,314,206	....	19,263,592	....	19,586,703
Ginger, preserved or pickled.....pounds..	(c)	7,123	(c)	14,295	142,698	6,309	429,198	17,917	340,690	17,306
Hay ....tons..	119,942	1,030,497	3,887	34,659	19,872	115,409	143,890	1,019,743	142,620	1,128,610
Hops ....pounds..	3,017,821	629,987	2,375,922	648,155	1,319,319	591,755	2,589,725	713,701	2,606,708	851,008
Indigo ....do....	3,522,016	1,696,641	3,097,340	1,815,411	3,127,357	1,698,583	2,746,944	1,446,490	3,139,063	1,402,894
Malt, barley ....bushels..	11,084	9,384	4,769	4,412	4,984	4,447	4,399	4,127	4,580	4,635
Malt extract, fluid or solid	....	11,485	....	6,917	....	5,320	....	4,320	....	4,863
Malt liquors:										
Bottled ....gallons..	1,048,994	1,025,867	733,535	695,102	918,562	917,186	1,081,818	1,079,723	1,151,891	1,166,123
Unbottled ....do....	1,915,650	534,426	1,777,202	506,428	1,928,672	570,692	2,228,502	647,533	2,447,555	719,092
Total ....do....	2,964,644	1,560,293	2,510,737	1,201,530	2,847,234	1,487,878	3,310,320	1,727,256	3,599,446	1,885,215
Nursery stock (plants, trees, shrubs, vines, etc.)[d]	....	963,977	....	762,158	....	768,982	....	972,885	....	1,098,932
Oil cake ....pounds..	3,098,361	20,313	2,159,809	8,799	1,885,648	9,553	208,657	1,437	448	64
Oil cake (substitute for india rubber)	....	(c)	....	(c)	....	1,149	....	846	....	(c)
Oils, vegetable:										
Fixed or expressed—										
Olive, salad ....gallons..	928,567	1,134,077	736,877	923,804	930,042	1,090,250	967,702	1,170,871	983,059	1,266,293
Other	....	2,353,084	....	2,434,209	....	2,519,157	....	3,290,656	....	3,422,170

Volatile, or essential	....	1,885,523	....	1,511,078	....	1,691,257	....	1,859,184	....	1,959,395
Total	....	5,372,684	....	4,869,091	....	5,300,664	....	6,320,711	....	6,647,858
Opium:										
Crude or unmanufactured....pounds..	1,072,914	2,184,727	123,845	265,607	513,499	1,223,951	544,938	1,123,756	583,208	1,259,726
Prepared ....do....	157,061	1,132,861	100,258	652,341	124,214	828,203	142,479	1,065,965	117,581	972,582
Total ....do....	1,229,975	3,317,588	224,103	917,948	637,713	2,052,154	687,417	2,189,721	700,789	2,232,308
Rice, rice meal, etc.:										
Rice ....do....	133,939,930	2,555,960	129,810,630	2,793,111	153,837,026	3,152,771	93,648,451	1,904,915	74,598,061	1,588,044
Rice flour, rice meal, and broken rice, pounds........	63,876,204	961,200	60,474,685	953,722	50,340,267	777,378	23,031,440	374,121	42,601,649	736,854
Total ....pounds..	197,816,134	3,517,160	190,285,315	3,746,833	204,177,293	3,930,149	116,679,891	2,279,036	117,199,710	2,324,898
Sauerkraut........	....	1,831	....	(c)	....	(c)	....	(c)	....	(c)
Seeds:										
Flaxseed, or linseed........bushels..	105,222	108,871	136,098	150,515	81,953	87,602	67,379	94,126	1,631,726	2,098,207
Other	....	1,315,055	....	1,081,251	....	1,134,243	....	1,700,922	....	1,940,987
Total........	....	1,423,926	....	1,231,766	....	1,221,845	....	1,795,048	....	4,039,194
Spices:										
Unground—										
Nutmegs ....pounds..	1,669,740	451,614	1,213,994	331,235	1,530,102	368,765	1,590,811	351,383	1,836,417	360,889
Pepper, black or white......do....	15,033,452	711,453	14,080,136	909,711	12,332,747	1,083,100	13,085,333	1,283,635	16,081,849	1,806,167
Other (free of duty)........do....	20,411,490	1,076,963	13,784,689	898,992	13,851,055	997,783	19,652,762	1,376,243	13,506,848	1,001,482
Ground (and other dutiable)....do....	3,030,031	336,686	2,658,706	264,691	3,346,925	332,653	4,516,709	390,004	3,786,623	394,571
Total ....do....	40,144,713	2,576,716	31,737,525	2,404,629	31,060,829	2,782,301	38,845,615	3,401,265	35,211,737	3,563,109
Spirits, distilled:										
Of domestic manufacture, returned, proof gallons........	956,760	863,558	854,586	734,901	998,173	834,948	687,024	630,574	875,099	794,594
Brandy........ proof gallons..	337,595	911,721	137,902	395,758	219,968	626,875	244,100	696,540	290,301	843,318
Other........do....	1,727,110	2,074,835	770,830	1,004,135	1,227,834	1,683,256	1,550,896	2,282,717	1,712,156	2,524,237
Total ....do....	3,021,465	3,850,114	1,763,318	2,134,794	2,445,975	3,145,079	2,482,020	3,609,831	2,877,556	4,162,149
Starch ....pounds..	2,941,253	51,812	6,120,924	103,780	8,542,897	140,528	11,767,924	222,296	7,302,501	179,340
Straw ....tons..	9,386	31,768	1,448	4,463	2,075	4,564	5,495	15,750	9,633	35,816

[a] Including nuts free of duty, except cocoanuts.
[b] Exclusive of nuts free of duty, except cocoanuts.
[c] Not stated.
[d] Apparently including natural flowers free of duty prior to July 24, 1897.

Agricultural imports of the United States during the five years ended June 30, 1901—Continued.

Articles imported.	1897.		1898.		1899.		1900.		1901.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Sugar and molasses:										
Molasses .... gallons..	3,702,471	$586,513	3,609,547	$544,016	5,821,556	$789,576	7,025,068	$890,524	11,453,156	$1,123,923
Sugar—										
Not above No. 16 Dutch standard—										
Beet .... pounds..	1,865,577,495	33,689,158	140,641,485	2,717,955	723,336,352	15,269,397	701,539,452	14,800,609	908,683,078	20,028,575
Cane and other .... do....	2,854,192,069	60,448,873	2,448,190,703	55,319,873	3,194,168,454	78,001,772	3,305,087,796	85,059,367	2,956,586,102	67,507,439
Above No. 16 Dutch standard . do....	199,136,169	4,928,150	101,088,663	2,434,921	62,745,763	1,692,951	11,459,282	390,998	109,736,660	2,951,786
Total sugar .... do....	4,918,905,733	99,066,181	2,689,920,851	60,472,749	3,980,250,569	94,964,120	4,018,086,530	100,250,974	3,975,005,840	90,487,800
Total sugar and molasses	....	99,652,694	....	61,016,765	....	95,753,696	....	101,141,498	....	91,611,723
Tea .... pounds..	113,347,175	14,835,862	71,957,715	10,054,283	74,089,899	9,675,081	84,845,107	10,558,110	89,806,453	11,017,876
Tobacco:										
Suitable for cigar wrappers .... do....	6,057,268	5,663,214	3,988,561	3,913,294	4,147,048	4,349,034	5,561,068	5,122,359	6,574,586	5,940,857
Other leaf, etc. (including stems) . do....	7,747,959	3,920,941	6,488,547	3,575,314	9,888,781	5,551,219	14,058,559	8,174,864	20,276,667	10,349,530
Total .... do....	13,805,227	9,584,155	10,477,108	7,488,608	14,035,829	9,900,253	19,619,627	13,297,223	26,851,253	16,290,387
Vanilla beans .... do....	165,091	884,865	63,997	279,755	272,174	1,235,412	255,966	1,209,334	248,988	875,229
Vegetables:										
Beans and dried peas .... bushels..	452,984	453,274	163,560	149,227	184,499	165,830	967,031	1,049,443	1,099,640	1,306,405
Cabbages .... number..	711,603	38,906	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Onions .... bushels..	566,158	627,273	488,853	429,173	771,960	499,520	546,798	357,901	774,042	509,552
Potatoes .... do....	246,178	115,584	1,171,378	473,154	530,420	294,391	155,861	147,349	371,911	224,759
Pickles and sauces	....	332,243	....	243,354	....	352,022	....	306,223	....	388,486
Other—										
In their natural state	....	256,752	....	239,733	....	312,673	....	371,963	....	366,971
Prepared or preserved	....	720,822	....	499,959	....	554,302	....	702,198	....	923,506
Total	....	2,610,854	....	2,034,600	....	2,178,738	....	2,935,077	....	3,719,679
Vinegar .... gallons..	76,125	21,519	85,556	22,313	93,443	23,534	122,479	20,724	135,883	34,222
Wafers, unmedicated	....	20,[illegible]	....	11,797	....	14,733	....	15,629	....	18,054

Wines:										
Champagne and other sparkling, dozen quarts	228,628	3,348,004	223,827	3,264,323	262,371	3,668,791	310,149	4,115,908	311,078	4,589,494
Still wines—										
Bottled ....dozen quarts	302,281	1,475,211	268,921	1,312,147	274,873	1,347,842	315,920	1,560,851	373,832	1,687,420
Unbottled ....gallons	2,997,552	2,039,250	1,930,870	1,392,710	2,253,226	1,573,573	2,533,828	1,744,736	2,785,850	1,942,322
Total	....	6,862,465	....	5,969,180	....	6,590,206	....	7,421,495	....	8,219,236
Total vegetable matter	....	286,285,280	....	213,658,788	....	257,688,943	....	279,054,986	....	285,105,393
Total agricultural imports	....	400,871,465	....	314,291,796	....	355,514,881	....	420,139,288	....	391,931,051

Agricultural exports (domestic) of the United States during the five years ended June 30, 1901.

Articles exported.	1897.		1898.		1899.		1900.		1901.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
ANIMAL MATTER.										
Animals, live:										
Cattle ....number	392,190	$36,357,451	439,255	$37,827,500	389,490	$30,516,833	397,286	$30,635,153	459,218	$37,566,980
Hogs ....do	28,751	295,938	14,411	110,487	33,031	227,241	51,180	394,813	22,318	238,465
Horses ....do	39,532	4,769,265	51,150	6,176,569	45,778	5,444,342	64,722	7,612,616	82,250	8,873,845
Mules ....do	7,473	545,331	8,098	664,789	6,755	516,908	43,369	3,919,478	34,405	3,210,267
Sheep ....do	244,120	1,531,645	199,690	1,213,886	143,286	853,555	125,772	733,477	297,925	1,933,000
Other, including fowls	....	68,771	....	250,175	....	322,037	....	289,494	....	236,319
Total	....	43,568,461	....	46,243,406	....	37,880,916	....	43,585,031	....	52,058,876
Beeswax ....pounds	195,048	56,462	151,094	41,827	152,494	41,916	319,379	91,913	140,276	39,464
Bones, hoofs, horns, and horn tips, strips, and waste	....	280,140	....	174,861	....	195,759	....	199,194	....	218,680
Bristles	....	415	....	(a)	....	(a)	....	1,446	....	3,968
Dairy products:										
Butter ....pounds	31,345,224	4,493,364	25,690,025	3,864,765	20,247,997	3,263,951	18,266,371	3,143,509	23,248,526	4,014,905
Cheese ....do	50,944,617	4,636,063	53,167,280	4,559,324	38,198,753	3,316,049	48,419,353	4,943,609	39,813,517	3,950,999
Milk	....	524,968	....	671,670	....	1,049,211	....	1,139,402	....	1,437,818
Total	....	9,654,395	....	9,095,759	....	7,629,211	....	9,226,520	....	9,403,722
Eggs ....dozens	1,300,183	180,954	2,754,810	448,370	3,693,611	641,385	5,920,727	984,081	3,692,875	676,232
Egg yolks	....	(a)	....	(a)	....	10,379	....	883	....	1,610

[a] Not stated.

Agricultural exports (domestic) of the United States during the five years ended June 30, 1901—Continued.

Articles exported.	1897.		1898.		1899.		1900.		1901.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
ANIMAL MATTER—continued.										
Feathers:										
Ostrich		$5,679		$157,553		$212,374		$280,309		$327,966
Other ... pounds	1,142,632	112,714								
Total		118,393		157,553		212,374		280,309		327,966
Fertilizers (refuse skins)		(a)		(a)		1,062		(a)		(a)
Glue ... pounds	1,400,863	132,581	2,318,711	209,441	2,368,087	222,072	2,349,014	225,844	2,703,400	254,447
Grease, grease scraps, and other soap stock		2,070,111		1,964,565		2,576,507		2,944,322		3,339,948
Hair (including manufactures of)		517,469		635,716		503,712		676,688		674,881
Hides and skins, other than furs ... pounds	31,119,166	2,388,530	11,536,073	1,015,032	10,140,840	929,117	7,486,256	804,674	11,161,749	1,064,952
Honey		22,368		93,504		55,900		30,191		55,574
Meat products:										
Beef products—										
Beef, canned ... pounds	54,019,772	4,656,308	37,109,570	3,279,657	38,385,472	3,503,293	55,553,745	5,233,982	53,445,521	5,307,501
Beef, fresh ... do	290,395,930	22,653,742	274,768,074	22,966,556	282,139,974	23,545,185	329,078,609	29,643,830	351,748,333	31,851,361
Beef, salted or pickled ... do	67,712,940	3,514,126	44,314,479	2,368,467	46,564,876	2,525,784	47,306,513	2,697,340	55,312,632	3,145,219
Beef, other cured ... do	939,448	83,701	1,589,052	150,051	1,579,313	145,996	2,319,165	197,051	789,235	72,677
Tallow ... do	75,108,834	2,782,595	81,744,809	3,141,653	107,361,009	4,367,356	89,030,943	4,398,204	77,166,889	3,848,561
Total beef products ... do	488,176,924	33,690,472	439,525,984	31,906,384	476,030,644	34,087,614	523,288,975	42,170,407	538,462,660	44,225,319
Hog products—										
Bacon ... do	500,399,448	34,187,147	650,108,933	46,380,918	562,651,480	41,557,067	512,153,729	38,975,915	456,122,741	37,499,026
Hams ... do	165,247,302	15,970,021	200,185,861	18,987,525	225,846,750	20,774,084	196,414,412	20,416,367	216,571,803	22,842,778
Pork, canned ... do	(b)	(b)	(b)	(b)	(b)	(b)	8,496,074	658,402	8,945,594	708,381
Pork, fresh ... do	1,306,424	94,816	12,224,285	815,075	41,310,364	2,722,661	25,946,905	1,925,772	30,728,586	2,424,537
Pork, salted or pickled ... do	66,768,920	3,297,214	88,133,078	4,906,961	137,197,200	7,917,066	133,199,683	8,243,797	138,643,611	9,926,633
Lard ... do	568,315,640	29,126,485	709,344,045	39,710,672	711,259,851	42,208,465	661,813,663	41,939,164	611,357,514	46,560,148
Total hog products [c] ... do	1,302,037,734	82,675,683	1,659,996,202	110,801,151	1,678,265,645	115,179,343	1,538,024,466	112,159,417	1,462,369,849	119,961,503
Mutton ... do	361,955	28,341	329,169	27,961	379,110	29,427	773,760	64,313	691,121	46,643
Oleo and oleomargarin—										
Oleo oil ... do	113,506,152	6,742,061	132,579,277	7,904,413	142,390,492	9,183,659	146,739,681	10,503,856	161,651,413	11,846,373
Oleomargarin (imitation butter), pounds	4,864,351	472,856	4,328,536	386,297	5,549,322	509,703	4,256,067	416,544	4,990,699	484,501
Total oleo and oleomargarin, pounds	118,370,503	7,214,917	136,907,813	8,290,710	147,939,814	9,693,362	150,995,748	10,920,400	166,642,112	12,330,874

Poultry and game		72,082		85,739		183,503		463,905		1,070,190
Sausage and sausage meat....pounds..	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	9,799,106	923,974
Sausage casings		1,514,651		1,821,519		1,671,052		2,307,571		2,778,854
Other meat products—[d]										
Canned		2,944,486		4,193,078		5,834,865		1,724,064		1,556,671
Other								3,941,394		3,212,009
Total meat products		128,140,632		157,126,542		166,679,166		173,751,471		186,106,037
Oils, animal, not elsewhere specified:										
Lard oil..........gallons..	961,407	419,803	775,102	305,825	917,007	412,447	738,724	337,260	766,753	438,645
Other, except whale and fish....do....	112,555	47,836	123,711	50,587	166,372	64,368	351,161	172,568	574,209	258,406
Total..........do....	1,073,962	467,639	898,813	356,412	1,083,379	476,815	1,119,885	509,828	1,340,962	697,051
Quills		19,264		14,413		12,213		11,105		8,261
Rennets, prepared		735		(a)		(a)		(a)		(a)
Silk waste..........pounds..	54,060	13,181	153,886	19,002	128,698	16,075	285,640	53,851	53,398	9,138
Silkworm eggs		25		(a)		(a)		(a)		(a)
Stearin..........pounds..	1,388,555	70,534	3,987,258	188,579	1,174,167	55,821	(e)	(e)	(e)	(e)
Wool..........do....	5,271,535	619,932	121,139	18,071	1,683,419	237,350	2,200,309	387,239	199,565	26,017
Total animal matter		188,322,221		217,808,053		218,377,750		233,764,590		254,966,844
VEGETABLE MATTER.										
Breadstuffs:										
Barley..........bushels..	20,030,301	7,646,384	11,237,077	5,542,040	2,267,403	1,375,274	23,661,662	11,216,694	6,293,207	2,883,565
Bread and biscuit..........pounds..	15,214,619	697,695	15,990,558	788,264	16,447,430	809,998	18,329,815	938,513	12,420,325	606,811
Buckwheat..........bushels..	1,677,102	678,959	1,370,403	589,285	1,533,980	846,028	426,822	254,847	123,540	79,120
Corn (maize)..........do....	176,916,365	54,087,152	208,744,939	74,196,850	174,089,094	68,977,448	209,348,284	85,206,400	177,817,965	82,527,983
Corn meal..........barrels..	475,263	902,061	827,651	1,766,068	791,488	1,775,868	943,782	2,148,410	896,877	2,065,432
Oats..........bushels..	35,096,736	8,756,207	69,130,288	20,632,914	30,309,778	9,787,540	41,369,415	12,504,654	37,146,812	11,765,330
Oatmeal..........pounds..	47,310,251	1,071,340	85,500,350	1,757,978	58,042,505	1,295,988	66,229,950	1,547,900	92,198,138	2,308,649
Rye..........bushels..	8,560,271	3,667,505	15,541,575	8,825,769	10,140,866	5,936,078	2,355,792	1,442,055	2,326,882	1,321,979
Rye flour..........barrels..	2,566	7,366	3,410	11,815	4,826	15,015	4,370	14,757	3,105	10,860
Wheat..........bushels..	79,562,020	59,920,178	148,231,261	145,684,659	139,432,815	104,269,169	101,950,389	73,237,080	132,060,667	96,771,743
Wheat flour..........barrels..	14,569,545	55,914,347	15,349,943	69,263,718	18,485,690	73,093,870	18,699,194	67,760,886	18,650,979	69,459,296
Preparations of, for table food				1,765,207		2,133,110		2,362,715		2,832,930
Other, for animal feed—										
Bran, middlings, and mill feed, tons		4,508,025	91,189	1,329,519	127,953	2,002,588	166,604	2,638,719	79,358	1,383,246
Dried grains and malt sprouts, tons			(a)	(a)	(a)	(a)	(a)	(a)	59,136	992,836
All other				1,743,033		1,681,725		1,470,448		584,838
Total		197,857,219		333,897,119		278,999,699		262,744,078		275,594,618

[a] Not stated.
[b] Included in "Other meat products."
[c] Prior to 1900 exclusive of canned pork.
[d] Prior to 1900 including canned pork.
[e] Included in "Lard substitutes, n. e. s."

Agricultural exports (domestic) of the United States during the five years ended June 30, 1901—Continued.

Articles exported.	1897. Quantity.	1897. Value.	1898. Quantity.	1898. Value.	1899. Quantity.	1899. Value.	1900. Quantity.	1900. Value.	1901. Quantity.	1901. Value.
VEGETABLE MATTER—continued.										
Broom corn		$136,007		$163,066		$185,902		$182,520		$237,863
Broom root (rice root)		(a)		(a)		10,975		6,140		1,708
Cider .... gallons	637,672	77,695	465,873	60,063	490,803	64,500	483,367	64,283	462,048	61,132
Coffee, green or raw .... pounds	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	497,559	72,584
Coffee and cocoa, ground or prepared, and chocolate		128,078		137,369		192,863		231,509		333,036
Compressed food		(a)		(a)		(a)		74,898		(a)
Cotton:										
In bales—b										
Sea-island .... bales	55,347	4,078,044	40,037	2,767,291	36,213	2,361,697	46,308	2,955,378	29,305	2,237,558
Sea-island .... pounds	21,585,360		15,610,302		14,142,052		18,199,967		11,373,867	
Upland and other .... bales	6,121,018	226,812,927	7,540,967	227,674,924	7,337,169	207,203,077	6,043,836	238,847,359	6,479,145	311,435,885
Upland and other .... pounds	3,082,169,589		3,834,653,993		3,759,268,241		3,082,383,221		3,319,516,581	
Total cotton in bales .... bales	6,176,365	230,890,971	7,581,004	230,442,215	7,373,382	209,564,774	6,090,144	241,832,737	6,508,450	313,673,443
Total cotton in bales .... pounds	3,103,754,949		3,850,264,295		3,773,410,293		3,100,583,188		3,330,890,448	
Waste cotton .... pounds	(a)	(a)	12,521,574	511,004	14,308,829	524,802	25,642,400	1,156,241	28,171,912	1,431,604
Total cotton .... do	3,103,754,949	230,890,971	3,862,785,869	230,953,219	3,787,719,122	210,089,576	3,126,225,588	242,988,978	3,359,062,360	315,105,047
Cotton-seed meats		37,970		(a)		(a)		(a)		(a)
Flowers, cut		1,429		2,967		2,355		4,169		1,787
Fruits and nuts:										
Fruits—										
Apples, dried .... pounds	30,775,401	1,340,159	31,031,254	1,897,725	19,305,739	1,245,733	34,964,010	2,247,551	28,309,023	1,510,581
Apples, green or ripe .... barrels	1,503,961	2,371,143	605,390	1,684,717	380,222	1,210,459	526,636	1,444,655	883,673	2,058,964
Oranges		(a)		339,396		282,313		271,468		436,560
Prunes .... pounds	(a)	(a)	15,940,791	1,021,888	5,615,565	380,847	25,922,371	1,646,332	10,021,564	589,113
Raisins .... do	(a)	(a)	3,109,639	167,062	4,659,807	242,620	2,415,456	139,689	3,512,164	218,715
Other green, ripe, or dried		2,172,199		2,033,845		1,997,649		2,545,451		2,716,269
Preserved—										
Canned		1,686,723		1,624,741		2,330,715		3,127,275		3,006,109
Other		43,276		82,504		66,899		63,448		71,597
Total fruits		7,613,500		8,851,878		7,757,235		11,486,172		10,607,908
Nuts		125,805		161,432		140,250		156,490		218,743
Total fruits and nuts		7,739,305		9,013,310		7,897,485		11,642,662		10,826,651

Ginseng .... pounds..	179,573	840,686	174,063	638,446	196,196	782,545	160,901	833,710	149,069	801,672
Glucose and grape sugar .... do....	194,419,250	2,736,674	196,864,605	2,871,839	229,003,571	3,624,890	221,901,459	3,600,139	204,209,974	3,113,898
Grasses, dried	....	17,766	....	26,499	....	26,063	....	20,148	....	18,295
Hay .... tons..	61,658	845,590	81,827	1,151,273	64,916	858,992	72,716	992,741	89,364	1,476,870
Hops .... pounds..	11,426,241	1,304,183	17,161,669	2,642,779	21,145,512	3,626,144	12,639,474	1,707,660	14,963,676	2,466,515
Lard substitutes, n. e. s. (cottolene, lardine, etc.)[a] .... pounds..	16,261,991	857,708	21,343,028	1,118,659	22,144,717	1,200,231	25,852,685	1,475,064	23,359,966	1,449,878
Malt .... bushels..	259,543	177,292	406,702	287,473	453,088	324,145	296,742	215,198	357,947	250,099
Malt sprouts	....	([a])	....	15,124	....	55,177	....	62,266	....	([a])
Malt liquors:										
Bottled .... dozen quarts..	549,910	636,837	406,231	497,031	1,433,799	1,733,373	1,578,240	1,945,059	1,351,779	1,643,517
Unbottled .... gallons..	390,048	87,112	391,802	88,548	602,055	154,751	761,411	194,157	333,666	79,508
Total	....	723,949	....	585,579	....	1,888,124	....	2,139,216	....	1,723,025
Nursery stock	....	135,047	....	96,330	....	134,929	....	107,172	....	134,961
Oil cake and oil-cake meal:										
Corn .... pounds..	([a])	([a])	2,202,680	20,286	1,922,264	17,623	4,883,776	45,783	12,703,209	131,774
Cotton-seed .... do....	623,386,638	5,515,800	919,727,701	8,040,710	1,079,993,479	9,253,398	1,143,704,342	11,229,188	1,258,657,317	13,119,968
Flaxseed, or linseed .... do....	433,106,448	4,095,244	436,206,321	4,540,824	487,177,390	5,277,744	483,130,182	5,528,331	455,154,860	5,471,930
Total[d] .... do....	1,056,493,086	9,611,044	1,358,136,702	12,601,820	1,569,093,133	14,548,765	1,631,723,300	16,806,302	1,726,545,386	18,723,672
Oils, vegetable:										
Corn .... gallons..	([a])	([a])	2,646,560	575,646	2,360,623	565,293	4,383,926	1,351,867	4,808,545	1,831,980
Cotton-seed .... do....	27,198,882	6,897,361	40,230,784	10,137,619	50,627,219	12,077,519	46,902,390	14,127,535	49,356,741	16,541,321
Linseed .... do....	111,262	42,700	90,074	38,439	107,000	47,681	103,494	54,148	99,919	66,653
Volatile, or essential—										
Peppermint .... pounds..	162,492	257,484	145,375	180,811	117,462	118,227	89,558	90,298	60,166	63,672
Other	....	146,569	....	201,497	....	162,358	....	166,424	....	169,004
All other	....	1,167,504	....	885,057	....	838,257	....	554,761	....	363,056
Total	....	8,511,618	....	12,019,069	....	13,809,335	....	16,345,056	....	19,035,686
Rice, rice meal, etc.:										
Rice .... pounds..	387,288	14,617	637,146	27,501	852,704	38,511	12,947,009	500,364	1,078,958	42,807
Rice bran, meal, and polish .... do....	3,518,466	20,113	5,563,841	35,498	14,481,985	80,298	28,119,408	167,023	24,448,888	143,922
Total .... do....	3,905,754	34,730	6,200,987	62,999	15,334,689	118,809	41,066,417	667,387	25,527,846	186,729
Rice root. (*See* Broom root.)										
Root beer .... dozen quarts..	([a])	([a])	([a])	([a])	([a])	([a])	3,439	4,661	1,751	2,018
Roots, herbs, and barks, n. e. s	....	154,347	....	147,839	....	169,828	....	237,527	....	275,150

[a] Not stated.
[b] Probably including waste cotton prior to 1898.
[c] In 1900–1901, including stearin.
[d] Prior to 1898 exclusive of corn oil cake, of which the exports were inconsiderable.

Agricultural exports (domestic) of the United States during the five years ended June 30, 1901—Continued.

Articles exported.	1897.		1898.		1899.		1900.		1901.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Seeds:										
Cotton .... pounds..	26,566,024	$170,604	32,764,781	$197,258	34,443,806	$197,023	49,855,238	$346,230	43,329,257	$366,953
Flaxseed, or linseed .... bushels..	4,713,747	3,850,835	257,228	231,237	2,830,991	2,815,449	2,743,266	3,475,417	2,755,683	4,319,102
Grass seed—										
Clover .... pounds..	13,042,994	1,003,157	31,155,381	1,892,101	19,980,434	1,264,922	32,069,371	2,379,372	11,998,674	1,063,506
Timothy .... do....	16,733,993	574,457	10,238,780	317,173	16,149,611	492,710	15,078,186	505,758	7,275,806	296,640
Other	....	(a)	....	167,109	....	156,200	....	165,063	....	144,948
Total grass seed	....	(a)	....	2,376,383	....	1,913,832	....	3,050,193	....	1,505,094
All other seeds	....	429,379	....	149,845	....	153,092	....	165,142	....	193,666
Total seeds	....	6,028,432	....	2,954,723	....	5,079,396	....	7,036,982	....	6,384,815
Spices	....	772	....	3,841	....	2,257	....	19,131	....	20,204
Spirits, distilled:										
Alcohol,[b] including cologne spirits, proof gallons	416,725	140,046	1,619,230	463,616	1,476,028	427,288	177,974	59,277	237,509	97,633
Brandy .... proof gallons..	11,815	12,640	24,886	39,455	20,944	29,289	80,259	83,698	15,323	28,176
Rum .... do....	808,393	1,102,267	607,634	845,673	850,719	1,175,306	670,410	903,808	1,076,711	1,468,110
Whisky—										
Bourbon .... do....	569,413	422,451	286,599	241,066	224,918	267,865	863,241	764,860	525,372	687,969
Rye .... do....	21,282	38,402	17,495	31,164	99,884	156,617	91,721	121,241	160,357	251,583
Other .... do....	500,338	225,897	36,869	30,149	19,536	24,372	18,585	24,921	23,562	44,670
Total .... do....	2,327,966	1,941,703	2,592,713	1,651,123	2,692,029	2,060,737	1,902,190	1,957,805	2,038,834	2,578,141
Starch .... pounds..	79,088,876	1,665,926	72,806,313	1,371,549	110,193,776	2,292,843	124,935,963	2,604,362	102,590,725	2,005,865
Straw	....	5,659	....	5,907	....	4,737	....	4,200	....	5,328
Sugar, molasses, and sirup:										
Molasses and sirup—										
Molasses .... gallons..	8,913,830	788,323	3,817,829	267,202	5,682,080	444,392	3,892,374	434,585	2,495,638	291,063
Sirup .... do....			7,573,541	794,727	10,070,650	1,465,849	11,139,770	1,682,202	15,092,321	2,235,014
Total molasses and sirup... do....	8,913,830	788,323	11,391,370	1,061,929	15,752,730	1,910,241	15,032,144	2,116,787	17,587,959	2,526,077

Sugar—										
Brown.....pounds..	1,107,864	35,367	460,682	17,353	403,119	14,275	322,252	11,262	147,221	6,056
Refined.....do....	7,197,355	341,641	6,047,608	301,511	9,462,228	426,202	22,192,351	1,004,135	8,727,639	437,523
Total sugar.....do....	8,305,219	377,008	6,508,290	318,864	9,865,347	440,477	22,514,603	1,015,397	8,874,860	443,579
Total sugar, molasses, and sirup.	.....	1,165,331	.....	1,380,793	.....	2,350,718	.....	3,132,184	.....	2,969,656
Teazels.....	.....	3,336	.....	13,290	.....	19,466	.....	21,882	.....	25,079
Tobacco:										
Leaf.....pounds..	305,978,292	24,513,567	252,258,902	21,924,337	272,421,295	25,170,771	334,604,210	29,163,086	306,900,934	27,475,466
Stems and trimmings.....do....	8,953,399	197,879	10,761,312	247,243	11,191,827	296,447	10,051,487	259,285	8,886,848	181,009
Total.....do....	314,931,691	24,711,446	263,020,214	22,171,580	283,613,122	25,467,218	344,655,697	29,422,371	315,787,782	27,656,475
Vegetables:										
Beans and peas.....bushels..	900,219	1,110,387	854,284	1,094,094	883,201	1,269,512	617,355	983,401	468,670	582,088
Onions.....do....	73,511	60,088	100,148	90,832	164,902	134,250	171,636	143,256	165,391	144,030
Potatoes.....do....	926,646	515,067	605,187	460,666	579,833	450,739	809,472	626,791	741,483	518,621
Canned vegetables.....	.....	408,840	.....	386,039	.....	555,691	.....	603,288	.....	528,914
Other, including pickles and sauces..	.....	243,542	.....	350,157	.....	388,908	.....	496,542	.....	544,764
Total.....	.....	2,337,924	.....	2,381,788	.....	2,799,400	.....	2,853,278	.....	2,598,417
Vinegar.....gallons..	93,969	11,572	108,657	12,939	107,317	13,488	115,372	12,583	83,780	13,231
Wines:										
Bottled.....dozen quarts..	16,794	69,444	9,672	46,721	10,973	52,015	9,854	49,927	9,901	43,013
Unbottled.....gallons..	1,389,375	629,270	1,623,103	682,028	1,498,078	624,315	1,408,859	575,665	1,117,858	461,560
Total.....	.....	698,714	.....	728,749	.....	676,330	.....	625,592	.....	504,573
Yeast.....	.....	42,849	.....	41,770	.....	36,061	.....	8,086	.....	6,809
Total vegetable matter.....	.....	501,432,972	.....	641,210,893	.....	574,4[illegible]3,983	.....	610,851,940	.....	696,661,487
Total agricultural exports.....	.....	689,755,193	.....	859,018,946	.....	792,811,733	.....	844,616,530	.....	951,628,331

[a] Not stated.

[b] Including wood alcohol prior to 1898, but not subsequently.

AVERAGE PRICES FOR IMPORTS AND EXPORTS.

[From Section of Foreign Markets.]

Average import price of agricultural products imported into the United States during each of the five fiscal years 1897–1901.

[The import prices of merchandise here given represent "the actual market value or wholesale price of such merchandise as bought and sold in usual wholesale quantities, at the time of exportation to the United States, in the principal markets of the country from whence imported, and in the condition in which such merchandise is there bought and sold for exportation to the United States, or consigned to the United States for sale, including the value of all cartons, cases, crates, boxes, sacks, and coverings of any kind, and all other costs, charges, and expenses incident to placing the merchandise in condition, packed ready for shipment to the United States." (Act of June 10, 1890.)
The export prices are the actual market values in the port of shipment.]

Articles imported.	Year ended June 30—					Annual average—	
	1897.	1898.	1899.	1900.	1901.	1892–1896.	1897–1901.
ANIMAL MATTER.							
Cattle, free of duty ..head..	$119.41	$132.81	$152.81	$193.89	$219.16	$10.28	$181.86
Cattle, dutiable ......do....	7.80	9.75	11.17	11.42	11.45	6.19	9.92
Total cattle...........do....	7.87	9.99	11.62	12.47	13.23	6.37	10.47
Horses, free of duty ..do....	138.85	181.82	277.65	278.25	371.15	387.05	279.63
Horses, dutiable......do....	58.38	117.92	129.01	131.61	144.59	83.05	98.40
Total horses ....do....	66.42	134.49	181.15	192.32	260.43	131.08	150.56
Sheep, free of duty...do....	13.70	14.05	19.25	19.91	24.11	20.37	17.82
Sheep, dutiable ......do....	2.45	2.73	3.36	3.47	3.60	3.03	3.09
Total sheep...........do....	2.51	2.82	3.47	3.58	3.73	3.21	3.19
Beeswax ....pound..	.249	.266	.243	.241	.261	.259	.251
Bristles, crude........do....	.611	.346	.579	.823	.433	[a].642	.567
Bristles, sorted, bunched, or prepared ....pound..	.903	.814	.788	.851	1.05	[a].933	.875
Total bristles ....do....	.903	.814	.785	.851	1.03	.958	.872
Butter ....do....	.160	.171	.167	.196	.208	.161	.189
Cheese.................do....	.135	.131	.132	.131	.138	.142	.134
Eggs ....dozen..	.082	.049	.095	.065	.083	.118	.078
Silk:							
Cocoons ....pound..	....	.381	.169	.608	1.05	.491	.455
Raw, or as reeled from the cocoon ...pound..	2.84	3.05	3.28	3.96	3.21	3.27	3.32
Waste ....do....	.285	.374	.421	.427	.551	.546	.407
Total silk.............do....	2.37	2.66	2.89	3.47	2.89	2.88	2.90
Wool, class 1, clothing:							
In the grease...pound..	.158	.170	.150	....	....	....	[b].160
Scoured ....do....	.265	.280	.155	....	....	....	[b].266
Total wool, class 1....do....	.171	.175	.150	.214	.161	.168	.175
Wool, class 2, combing:							
In the grease...pound..	.189	.199	.272	....	....	....	[b].194
Scoured ....do....	.211	.210	.165	....	....	....	[b].211
Total wool, class 2....do....	.189	.199	.272	.209	.196	.216	.197
Wool, class 3, carpet:							
In the grease.....do....	.105	.096	.094	....	....	....	[b].099
Scoured ....do....	.118	.088	.097	....	....	....	[b].117
Total wool, class 3....do....	.105	.096	.094	.091	.095	.094	.097
Total wools...........do....	.152	.126	.108	.130	.121	.129	.136
Glue..................do....	.096	.101	.089	.098	.101	.091	.098
Hides and skins, other than furs:							
Goatskins ......pound..	.227	.243	.265	.268	.279	[a].211	.259
Hides of cattle ...do....	.106	.108	.101	.118	.113	[a].105	[c].112
Other.............do....		.140	.148	.165	.167		[c].157
Total hides and skins.do....	.135	.151	.157	.167	.172	[a].130	.158
Honey..............gallon..	.415	.895	.409	.482	.459	.404	.410
Sausage, Bologna ..pound..	.233	....	....	....	....	[d].225	[e].233
Oils, animal, except whale and fish ....gallon..	.158	.404	.173	.180	.217	.357	.212
Stearin ....pound..	....	....	.011	.018	.018	[f].073	[g].017
VEGETABLE MATTER.							
Argols, or wine lees .pound..	.084	.083	.082	.087	.087	.081	.085
Barley ....bushel..	.310	.351	.486	.480	.492	.458	.357
Corn (maize).........do....	.329	.433	.388	.783	.661	.570	.489
Oats ....do....	.260	.370	.385	.442	.434	.283	.365
Oatmeal............pound..	.021	.055	.059	.057	.057	.055	.036
Rye ....bushel..	2.36	.404	2.44	1.11	.717	.771	.440
Wheat................do....	.767	.952	.752	.759	.697	.698	.815
Wheat flour ....barrel..	4.41	4.46	4.48	5.26	5.34	5.03	4.60
Broom corn ....ton..	....	....	....	90.87	103.00	....	[h]90.34
Chocolate, prepared or manufactured, not including confectionery ....pound..	.163	.151	.187	.199	.197	.195	.177

[a] Annual average, 1895–1896.
[b] Annual average, 1897–1899.
[c] Annual average, 1898–1901.
[d] Statistics for 1896 only.
[e] Statistics for 1897 only.
[f] Annual average for the two years 1893 and 1896.
[g] Annual average, 1899–1901.
[h] Annual average, 1900–1901.

Average import price of agricultural products imported into the United States during each of the five fiscal years 1897–1901—Continued.

Articles imported	Year ended June 30— 1897.	1898.	1899.	1900.	1901.	Annual average— 1892–1896.	1897–1901.
VEGETABLE MATTER—cont'd.							
Cider .... gallon..	....	....	....	$0.864	$0.799	[a] $0.270	[b] $0.823
Cocoa, crude, and leaves and shells of .... pound..	$0.095	$0.136	$0.143	.136	.141	.131	.131
Cocoa, prepared or manufactured .... pound..	.297	.357	.319	.310	.296	.350	.312
Total cocoa .... do....	.105	.143	.147	.140	.144	.143	.136
Coffee .... do....	.111	.075	.066	.067	.074	.161	.078
Chicory root, raw, unground .... pound..	.014	.016	.015	.015	.019	.017	.014
Chicory root, roasted, ground, or otherwise prepared .... pound..	.035	....	.033	.034	.032	.035	[c] .033
Total chicory root .... do....	.014	....	.027	.019	.024	.019	[c] .015
Coffee substitutes, n. e. s., pound	.037	.034	.037	.039	.044	.038	.038
Total coffee substitutes, pound	.017	....	.033	.028	.034	.022	[c] .020
Cotton .... pound..	.113	.095	.100	.118	.146	.109	.114
Flax .... ton..	206.53	215.88	201.81	236.30	273.44	266.58	226.17
Hemp .... do....	121.97	139.49	121.06	132.43	153.52	131.61	133.94
Istle, or Tampico fiber. do....	53.20	50.84	64.81	82.65	70.08	56.94	64.98
Jute and jute butts... do....	23.93	22.65	27.61	38.53	42.78	28.44	31.60
Manila hemp .... do....	73.68	61.44	116.77	168.27	162.69	112.88	114.99
Sisal grass .... do....	60.61	74.58	128.12	153.17	113.77	84.15	108.03
Fibers, vegetable, n. e. s., ton	66.32	62.22	68.74	81.36	95.46	83.95	74.69
Fruit juices, n. e. s.:							
Prune juice or prune wine .... gallon..	.701	.890	.776	.815	.713	.855	.774
Other, including cherry juice .... gallon..	....	.489	.517	.617	.498	....	[d] .531
Total fruit juices ..... do....	....	.621	.631	.707	.600	....	[d] .642
Currants .... pound..	.020	.033	.026	.025	.057	.023	.030
Dates .... do....	.024	.027	.025	.021	.020	.027	.023
Figs .... do....	.060	.053	.049	.058	.046	.053	.058
Lemons .... do....	....	....	.019	.023	.024	....	[e] .022
Oranges .... do....	....	....	.013	.016	.014	....	[e] .014
Plums and prunes.... do....	.103	.130	.106	.108	.084	.042	.102
Raisins .... do....	.045	.058	.057	.052	.077	.044	.054
Almonds .... do....	.091	.115	.123	.150	.184	.115	.127
Ginger, preserved or pickled, pound	....	....	.044	.042	.051	....	[e] .046
Hay .... ton..	8.59	8.92	5.81	7.09	7.91	8.58	7.74
Hops .... pound..	.209	.273	.449	.276	.326	.306	.288
Indigo .... do....	.482	.580	.543	.527	.417	.668	.516
Malt, barley .... bushel..	.847	.925	.892	.938	1.01	.938	.906
Malt liquors, bottled, gallon	.978	.948	.999	.998	1.01	.964	.990
Malt liquors, unbottled, gallon	.279	.285	.296	.291	.294	.314	.289
Total malt liquors.. gallon..	.526	.479	.523	.522	.524	.539	.516
Oil cake .... pound..	.007	.004	.005	.007	.148	.008	.005
Olive oil, salad...... gallon..	1.22	1.25	1.17	1.21	1.29	1.22	1.28
Opium, crude or unmanufactured .... pound..	2.04	2.14	2.38	2.06	2.16	2.01	2.13
Opium, prepared ..... do....	7.21	6.51	6.67	7.48	8.27	6.86	7.25
Total opium .... do....	2.70	4.10	3.22	3.19	3.19	2.69	3.08
Rice .... do....	.019	.022	.020	.020	.021	.018	.020
Rice flour, rice meal, and broken rice....... pound..	.015	.016	.015	.016	.017	.015	.016
Total rice, rice meal, etc., pound	.018	.020	.019	.020	.020	.017	.019
Flaxseed, or linseed, bushel	1.03	1.11	1.07	1.40	1.29	1.11	1.26
Spices, unground:							
Nutmegs .... pound..	.270	.273	.241	.221	.197	.379	.238
Pepper, black or white, pound	.047	.065	.088	.098	.112	.052	.082
Other (free of duty), pound	.053	.065	.072	.070	.074	.060	.066
Spices, ground (and other dutiable) .... pound..	.111	.100	.099	.086	.104	.128	.099
Total spices........... do....	.064	.076	.090	.088	.101	.073	.083

[a] Statistics for 1893 only.
[b] Annual average, 1900–1901.
[c] Annual average for the four years, 1897, 1899, 1900, and 1901.
[d] Annual average, 1898–1901.
[e] Annual average, 1899–1901.

Average import price of agricultural products imported into the United States during each of the five fiscal years 1897-1901—Continued.

Articles imported.	Year ended June 30—					Annual average—	
	1897.	1898.	1899.	1900.	1901.	1892-1896.	1897-1901.
VEGETABLE MATTER—cont'd.							
Spirits distilled:							
Of domestic manufacture, returned, proof gallon	$0.903	$0.860	$0.836	$0.918	$0.908	$0.980	$0.883
Brandy...proof gallon	2.70	2.87	2.85	2.85	2.90	2.71	2.82
Other...do	1.20	1.30	1.37	1.47	1.47	1.07	1.37
Total distilled spirits .do	1.27	1.21	1.29	1.45	1.45	1.24	1.34
Starch...pound	.018	.017	.016	.019	.025	.021	.019
Straw...ton	3.38	3.08	2.20	2.87	3.72	3.50	3.29
Molasses...gallon	.158	.151	.136	.127	.098	.115	.124
Sugar not above No. 16 Dutch standard:							
Beet...pound	.018	.019	.021	.021	.022	.026	.020
Cane and other...do	.021	.023	.024	.026	.023	.027	.023
Sugar above No. 16 Dutch standard...pound	.025	.024	.027	.034	.027	.031	.026
Total sugar...do	.020	.022	.024	.025	.023	.027	.023
Tea...do	.131	.140	.131	.124	.123	.147	.129
Tobacco:							
Suitable for cigar wrappers...pound	.935	.981	1.05	.921	.904	1.06	.949
Other leaf, etc. (including stems)...pound	.506	.551	.561	.581	.510	.396	.540
Total tobacco...do	.694	.715	.705	.678	.607	.520	.667
Vanilla beans...do	5.36	4.37	4.54	4.72	3.52	3.71	4.46
Beans and dried peas, bushel	1.01	.912	.899	1.09	1.19	1.01	1.09
Cabbages...number	.055	......	......	......	......	[a] .044	[b] .055
Onions...bushel	1.12	.878	.647	.655	.658	......	.771
Potatoes...do	.591	.404	.555	.915	.604	.472	.519
Vinegar...gallon	.270	.261	.252	.251	.252	.279	.256
Champagne and other sparkling wines, dozen quarts	14.64	14.58	13.98	13.27	14.75	14.60	14.21
Still wines:							
Bottled..dozen quarts	4.77	4.88	4.90	4.94	4.51	4.99	4.79
Unbottled...gallon	.680	.721	.698	.689	.697	.702	.695

[a] Statistics for 1896 only.

[b] Statistics for 1897 only.

Average export price of domestic agricultural products exported from the United States during each of the five fiscal years 1897–1901.

Articles exported.	Year ended June 30—					Annual average—	
	1897.	1898.	1899.	1900.	1901.	1892–1896.	1897–1901.
ANIMAL MATTER.							
Cattle .... head..	$92.70	$86.12	$78.35	$77.11	$81.81	$91.54	$83.23
Hogs .... do....	10.30	7.67	6.88	7.71	10.68	12.08	8.46
Horses .... do....	120.64	120.75	118.93	117.62	107.89	161.80	116.00
Mules .... do....	72.97	82.09	76.52	90.38	93.31	90.99	88.48
Sheep .... do....	6.27	6.08	5.96	5.83	6.49	6.13	6.20
Beeswax .... pound..	.289	.277	.275	.288	.281	.272	.283
Butter .... do....	.143	.150	.161	.172	.173	.165	.158
Cheese .... do....	.091	.086	.087	.102	.099	.093	.093
Eggs .... dozen..	.139	.163	.174	.166	.183	.172	.169
Feathers, other than ostrich .... pound..	.099	....	....	....	....	[a].156	[b].099
Glue .... do....	.095	.090	.094	.096	.094	.100	.094
Hides and skins, other than furs .... pound..	.077	.088	.092	.107	.095	[c].082	.087
Beef, canned .... do....	.086	.088	.091	.094	.099	.090	.092
Beef, fresh .... do....	.078	.084	.083	.090	.091	.085	.086
Beef, salted or pickled, pound	.052	.053	.054	.057	.057	.056	.055
Beef, other cured ... pound..	.089	.094	.092	.085	.092	.094	.090
Tallow .... do....	.037	.038	.041	.049	.050	.049	.043
Bacon .... do....	.068	.071	.074	.076	.082	.084	.074
Hams .... do....	.097	.095	.092	.104	.105	.106	.099
Pork, canned .... do....	....	....	....	.077	.079	....	.078
Pork, fresh .... do....	.073	.067	.066	.074	.079	.076	.072
Pork, salted or pickled, pound	.049	.056	.058	.062	.072	.068	.061
Lard .... pound..	.051	.056	.059	.063	.076	.079	.061
Mutton .... do....	.078	.085	.078	.083	.067	.080	.078
Oleo oil .... do....	.059	.060	.064	.072	.073	.093	.066
Oleomargarin (imitation butter) .... pound..	.097	.089	.092	.098	.097	.106	.095
Sausage and sausage meat, pound	....	....	....	....	.094	....	[d].094
Animal oils, n. e. s.:							
Lard oil .... gallon..	.437	.395	.450	.457	.572	.581	.460
Other, except whale and fish ...... gallon..	.425	.409	.387	.453	.450	.523	.437
Total animal oils, n. e. s., gallon	.435	.397	.440	.455	.520	.568	.455
Silk waste .... pound..	.244	.123	.125	.189	.171	.353	.165
Stearin .... do....	.051	.047	.048	....	....	.051	[e].048
Wool .... do....	.118	.149	.141	.176	.130	.123	.136
VEGETABLE MATTER.							
Barley .... bushel..	.382	.493	.607	.474	.458	.466	.451
Bread and biscuit .. pound..	.046	.049	.049	.051	.049	.048	.049
Buckwheat .... bushel..	.405	.480	.552	.597	.640	....	.477
Corn (maize) .... do....	.306	.355	.396	.407	.464	.473	.385
Corn meal .... barrel..	1.90	2.18	2.24	2.28	2.30	2.30	2.20
Oats .... bushel..	.249	.298	.328	.302	.317	.338	.298
Oatmeal .... pound..	.023	.021	.022	.023	.025	.026	.023
Rye .... bushel..	.428	.508	.585	.612	.568	.382	.544
Rye flour .... barrel..	2.87	3.46	3.11	3.38	3.50	3.63	3.27
Wheat .... bushel..	.753	.988	.748	.718	.733	.796	.798
Wheat flour .... barrel..	3.84	4.51	3.95	3.62	3.72	4.12	3.91
Bran, middlings, and mill feed .... ton..	....	14.58	15.65	15.84	17.43	....	15.81
Dried grains and malt sprouts .... ton..	....	....	....	....	16.79	....	[d]16.79
Cider .... gallon..	.122	.129	.131	.133	.132	.135	.129
Coffee, green or raw. pound..	....	....	....	....	.146	....	[d].146
Cotton, sea-island .... do....	.189	.177	.167	.164	.197	.196	.178
Cotton, upland and other, pound	.074	.059	.055	.077	.094	.076	.071
Total cotton in bales, pound	.074	.060	.056	.078	.094	.077	.071
Waste cotton .... pound..	....	.041	.037	.045	.051	....	[f].045
Total cotton .... do....	.074	.060	.055	.078	.094	.077	.071
Apples, dried .... do....	.044	.061	.065	.064	.053	.053	.057
Apples, green or ripe, barrel	1.58	2.78	3.18	2.74	2.33	2.55	2.25
Prunes .... pound..	....	.064	.068	.064	.059	....	[f].063

[a] Annual average for the three years 1893, 1895, and 1896.
[b] Statistics for 1897 only.
[c] Annual average, 1895–1896.
[d] Statistics for 1901 only.
[e] Annual average, 1897–1899.
[f] Annual average, 1898–1901.

Average export price of domestic agricultural products exported from the United States during each of the five fiscal years 1897-1901—Continued.

Articles exported.	Year ended June 30—					Annual average—	
	1897.	1898.	1899.	1900.	1901.	1892-1896.	1897-1901.
VEGETABLE MATTER—cont'd.							
Raisins.............pound..	....	$0.054	$0.052	$0.058	$0.062	....	[a]$0.056
Ginseng.............do....	$4.68	3.67	3.99	5.18	5.38	$3.41	4.53
Glucose and grape sugar, pound	.014	.015	.016	.016	.015	.019	.015
Hay.................ton..	13.71	14.07	13.23	13.65	16.53	15.58	14.37
Hops...............pound..	.114	.154	.171	.135	.165	.163	.152
Lard substitutes, n. e. s. (cottolene, lardine, etc.),[b] pound	.053	.052	.051	.057	.062	[c].070	[d].059
Malt...............bushel..	.612	.707	.715	.725	.699	.716	.695
Malt liquors, bottled, dozen quarts	1.16	1.22	1.21	1.23	1.22	1.31	1.21
Malt liquors, unbottled, gallon	.223	.226	.257	.255	.238	.255	.214
Oil cake and oil-cake meal:							
Corn...........pound..	....	.009	.009	.010	.010	....	[a].010
Cotton seed.......do....	.009	.009	.009	.010	.010	[e].009	.009
Flaxseed, or linseed, pound	.009	.010	.011	.011	.012	[e].011	.011
Total oil cake and oil-cake meal............pound..	.009	.009	.009	.010	.011	.011	.010
Corn oil............gallon..	....	.218	.239	.308	.381	....	[a].305
Cotton-seed oil.......do....	.254	.252	.239	.301	.335	.343	.279
Linseed oil..........do....	.384	.427	.446	.523	.667	.518	.488
Peppermint oil.....pound..	1.58	1.24	1.01	1.01	1.06	2.46	1.24
Rice.................do....	.038	.043	.045	.039	.040	[c].021	.039
Rice bran, meal, and polish, pound	.006	.006	.006	.006	.006	[c].008	.006
Total rice, rice meal, etc., pound	.009	.010	.008	.016	.007	.009	.012
Root beer....dozen quarts..	....	....	....	1.36	1.15	....	[d]1.29
Cotton seed........pound..	.006	.006	.006	.007	.008	.007	.007
Flaxseed, or linseed.bushel..	.820	.899	.995	1.27	1.57	1.14	1.10
Clover seed.........pound..	.077	.061	.063	.074	.089	.096	.070
Timothy seed.........do....	.034	.031	.031	.034	.041	.048	.033
Alcohol, including cologne spirits......proof gallon..	.336	.286	.289	.333	.411	.308	.302
Brandy...............do....	1.07	1.59	1.40	1.01	1.84	.832	1.26
Rum..................do....	1.36	1.39	1.38	1.35	1.36	1.23	1.37
Bourbon whisky.......do....	.742	.841	1.19	.886	1.31	.942	.965
Rye whisky...........do....	1.80	1.78	1.57	1.32	1.57	1.16	1.53
Distilled spirits, n. e. s. do....	.451	.818	1.25	1.34	1.90	.459	.584
Total distilled spirits.do....	.834	.637	.773	1.03	1.26	.872	.884
Starch..............pound..	.021	.019	.021	.021	.020	.030	.020
Molasses............gallon..	....	.070	.078	.112	.117	....	[a].090
Sirup.................do....	....	.105	.146	.151	.148	....	[a].141
Total molasses and sirup, gallon	.088	.093	.121	.141	.111	.108	.122
Sugar, brown.......pound..	.032	.038	.035	.035	.041	.035	.035
Sugar, refined........do....	.047	.050	.045	.045	.050	.046	.047
Total sugar..........do....	.045	.049	.045	.045	.050	.046	.046
Tobacco, leaf.........do....	.080	.087	.092	.087	.090	.086	.087
Tobacco stems and trimmings............pound..	.022	.023	.026	.026	.020	.035	.024
Total tobacco.........do....	.078	.084	.090	.085	.088	.081	.086
Beans and peas....bushel..	1.23	1.28	1.41	1.69	1.84	1.61	1.48
Onions...............do....	.817	.907	.814	.835	.871	.920	.847
Potatoes.............do....	.556	.761	.777	.774	.699	.724	.702
Vinegar............gallon..	.123	.119	.126	.109	.158	.142	.125
Wines, bottled, dozen quarts	4.14	4.83	4.74	5.07	4.34	4.36	4.57
Wines, unbottled...gallon..	.453	.420	.417	.409	.413	.486	.422

[a] Annual average, 1898-1901.
[b] In 1900-1901 including stearin.
[c] Annual average, 1893-1896.
[d] Annual average, 1900-1901.
[e] Annual average, 1895-1896.

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